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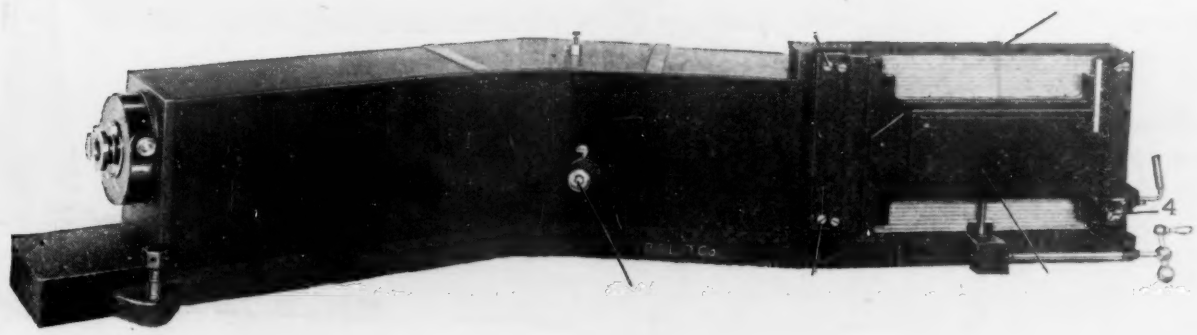

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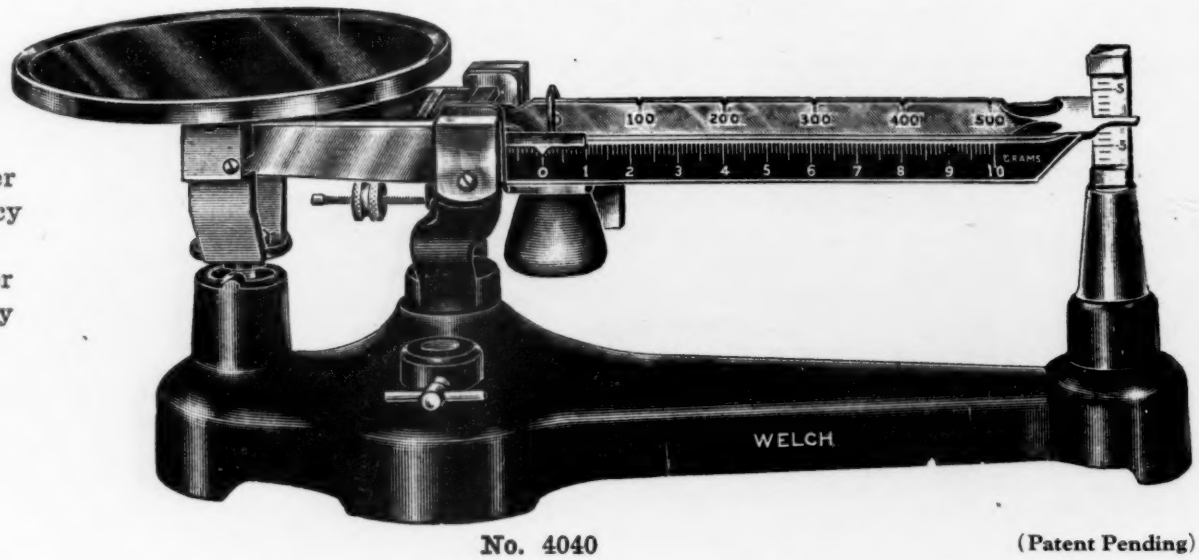

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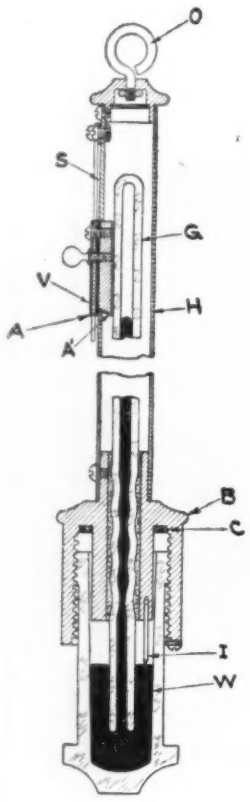

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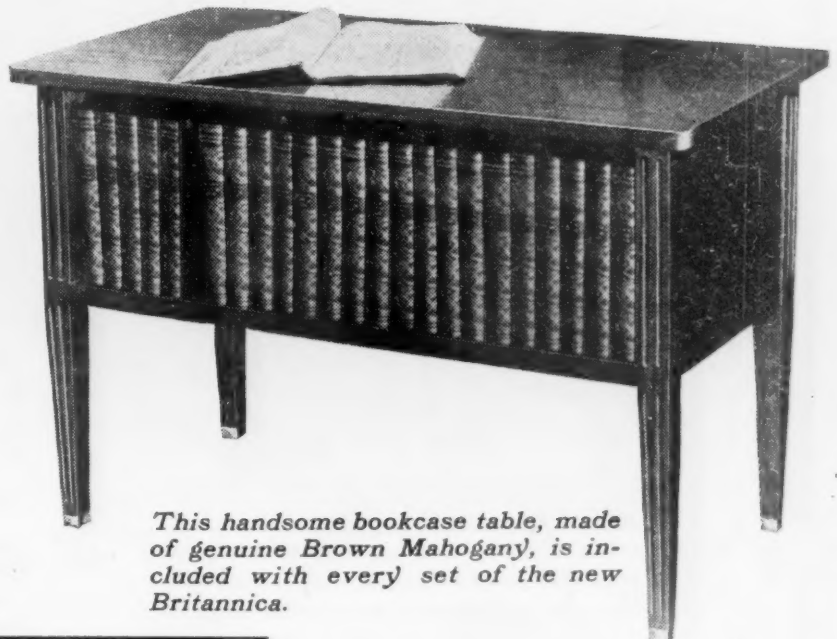

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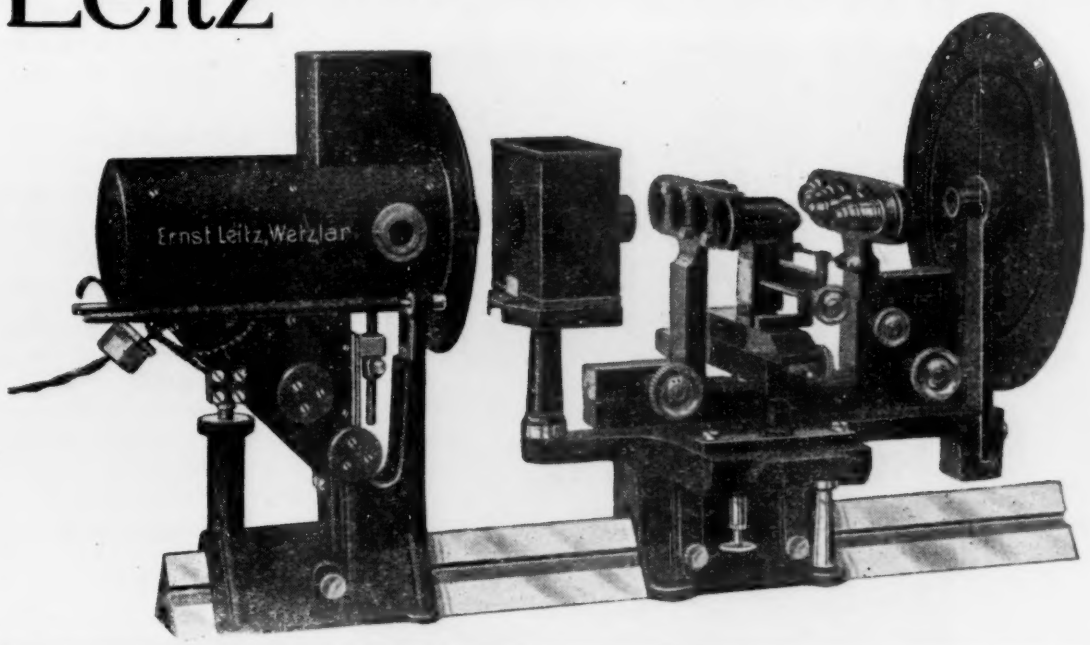

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AFRICA AND SCIENCE[1]

By JAN H. HOFMEYR

PRESIDENT OF THE SOUTH AFRICAN ASSOCIATION

TO-NIGHT I enter upon the consummation of what is at once the highest and the least merited distinction which it has been my privilege to receive. To those who called me to the office of president of the South African Association for the Advancement of Science I tender my sincere thanks. I make myself no illusions in respect of the adequacy of my claims to that honor on the ground either of scientific attainment or of services rendered to the cause of science, nor would I have our visitors remain for a moment without the knowledge that my scientific qualifications for this presidential chair are of the slightest. They are far less indeed than those of that distinguished statesman to whom when he had remarked to the great Faraday in relation to an important new discovery in science, "But after all, what is the use of it?" the scientist replied, "Why, sir, there is every probability that you will soon be able to tax it." The presidency of this association is an honor the conferment of which upon myself has never seemed to fall properly within the scope of my ambitions; it imposes responsibilities for the discharge of which I am all too scantily equipped; and I can only seek to justify my election in a manner similar to that which Mr. Stanley Baldwin followed when he was chosen to be president of the Classical Association in England. I can but say that, while it is to the scientist that we look for the advancement and the progress of science, the effectiveness with which his work is brought to fruition does depend in some measure on the interest, the sympathy and the enthusiasm with which his achieve-

[1] Address at the inaugural meeting of the British Association for the Advancement of Science, Cape Town, South Africa, July 22, 1929.

ments are followed up by that army of plain, ordinary men, in which I gladly count myself a musket bearer. In no other capacity dare I venture to address you. It was once said by a literary man of some distinction that the man of science appears to be the only man in the world who has something to say, and he is the only man who does not know how to say it. There is an obvious rejoinder, that the man of letters frequently has nothing to say, but says it at great length. I dare not claim to be a man of science. I can only hope that I shall not be deemed to-night to have qualified for consideration as a man of letters in the sense of that retort.

The honor which has been conferred upon me is the greater because of the special significance which attaches to my year of office. It is the year of the keenly anticipated second visit of the British Association for the Advancement of Science to South Africa, and for that reason my first words to-night are, happily, words of welcome. Not merely the association for which I speak, but all South Africa, rejoices in the presence of the British Association and its distinguished members. To its parent body, which can look back upon all but a century of glorious achievement, this stripling association brings its tribute of respectful admiration and good-will. To the great organization of scientific men, the history of which is the history of the advancement of science in Britain, which has a presidential roll adorned by names such as Brewster and Tyndall, Huxley and Kelvin, Rayleigh and Lister, this land of ours, mindful of its debt to science, conscious of the gifts that science can yet bring to it, extends the hand of friendship, in gratitude for the honor of this visit, and in appreciation of the stimulus to its progress and development which must needs attend it.

We have reason, indeed, to be grateful to the British Association for its achievement and its significance. If I might select three distinctive features in its record, they would be these. First, its contribution, direct and indirect, to those great triumphs of British science in the nineteenth century which are the possession not of an age, nor of a nation, but of all time and of every land. Directly it has initiated, correlated and contributed towards work of great scientific value; indirectly it has inspired much constructive activity, while its meetings year after year have done more than any other single factor to stimulate and hasten the onward march of science.

Next I would dwell on its maintenance of a broad view of the scope and function of science, and, coupled with that, the emphasis laid by it on the essential homogeneity of science conceived thus broadly, and the interdependence of its several branches. The association had no lack of opposition to encounter at its coming to birth. Those who interpreted science primarily in the medieval sense as being limited to the sciences of introspection had still but scant respect for the claims of the sciences of observation. When in the second year of its existence the association visited Oxford, Keble protested vigorously against the university's reception of what he called a hodge-podge of philosophers. This hodge-podge, be it noted, included Brewster and Dalton and Faraday. But the association did not react into narrowness. It remained true to the broad conception of *scientia* which was held by its founders, one of whom affirmed in striking language at the first meeting that "The chief interpreters of nature have always been those who have grasped the widest fields of inquiry, who have listened with the most universal curiosity to all information, and felt an interest in every question which the one great system of nature represents." The association has imposed no narrow restrictions on the extension of the sphere of its activity; within that ever-widening sphere it has maintained a spirit of cooperation between workers in diverse fields which has been worthy of the best traditions of Francis Bacon. It has had its reward—in greater effectiveness of work in its own sphere, and in the permeation of the kingdom of learning with the atmosphere of good-will. By way of illustration of this last point, may I, as one whose first allegiance is to the classics, mention the fact that the roll of twenty-six presidents of the Classical Association of England includes five fellows of the Royal Society, names such as Geikie, Osler and D'Arcy Thomson, and if it is not too presumptuously personal to refer to it, I would add, that when the South African Association elected me as its president, it chose one who was then president of the Classical Association of South Africa.

Lastly, I would select as characteristic of the British Association its success in maintaining the contacts of science with the public on the one hand and the state on the other. One of the aims which its founders set forth was "to obtain more general attention for the objects of science"; they sought to create a body which would make its appeal to the educated public as a whole, to fashion an instrument for the interpretation of the sometimes highly technical results of scientific investigation to the man in the street. They realized that the scientist received much from the public, that to the public he must freely give, and that the giving would not be without its due reward of new inspiration and renewed enthusiasms. There were some who opposed the nascent association in the fear that science might degrade itself by making too popular an appeal. That fear has been belied in the passing of the years. The association has kept

touch with the public, it has "demonstrated to all men that science is thinking with them and for them," it has secured their interest and their sympathy, but it has never paid for that achievement the price of a lowering of its aims or of its standards. It is its success in this respect that has secured for it the prestige which has enabled it time and again to stand forth as the ambassador of science to the state, and so to play an important part in initiating and furthering enterprises of great national and scientific significance.

For these reasons and for much else South Africa is proud and happy to be able to welcome and do honor to the British Association for the Advancement of Science. We welcome it the more heartily because of our consciousness of the greatness of our indebtedness to the first visit of the association twenty-four years ago. To that visit, with which there will always be linked a name honored in the history of South Africa, as it is in the annals of science—I refer to Sir David Gill—this country still looks back with grateful recollection. It marked the commencement of an epoch in our scientific history, the epoch of the consolidation of the position of science in South Africa.

Let us view the position of science in our country as it was in 1905. On the academic side it is the nakedness of the land that chiefly impresses us. South Africa then had but one university, and it was in reality only a board of examiners for the candidates presented by various colleges, which were all, without exception, inadequately staffed and poorly equipped. In the subjects which fell within the scope of the association, as it was defined in 1905, there were in all the colleges taken together in that year only forty-nine workers, thirty-three professors and sixteen others. When it is remembered that this was the total number of teachers of all branches of science spread over seven different institutions, all purporting to do university work, it is painfully obvious how little time was available for scientific research and investigation. Nor was the work done, measured in terms of the number of graduates, very impressive. The number of those who in 1905 qualified for degrees in pure and applied science was only twenty-seven. Outside of the colleges scientific workers were to be found mainly in government departments, then still small and inadequately staffed, and working in isolation in the four South African colonies. In most branches the state's scientific activities were still in their earliest infancy. The organization was only just commencing to be built up. As part of these activities there fall to be mentioned the two astronomical observatories at that time in operation: the Royal Observatory at Cape Town, then already full of years and of honor, and the Johannesburg Observatory which, thanks largely to the representations made by this association of ours, had been established a few months before the 1905 meeting. In regard to scientific societies there is but little to record. There were in existence in 1905 a small South African Philosophical Society (now known as the Royal Society of South Africa), the Geological Society of South Africa, the Cape Society of Engineers, the Chemical Metallurgical and Mining Society and also this Association for the Advancement of Science, which had come into existence a bare three years previously. It was, indeed, the day of small things, and small also was the achievement which science in South Africa at that date had to its credit. If one leaves out of account the work of Sir David Gill and the scientific endeavor which had been put into the development of the gold-mining industry of the Witwatersrand, there is little indeed of permanent significance that remains.

Against this picture it is appropriate to set the picture of South African science as it will unfold itself to our visitors to-day. They will find three vigorous single-college teaching universities, which have in recent years made remarkable progress in the attainment of the standards of similar institutions in older lands, and also a federal university with six constituent colleges, which, like the single-college universities, are, in human and material equipment and in the output of the results of scientific investigation, very far ahead of their predecessors of 1905. Against the forty-nine workers of 1905 we can now set 429—134 professors and 295 others—within the range at present covered by the activities of this association. The twenty-seven graduates of 1905 have increased to 275 in 1928. To the scientific societies of 1905 there have been added, since the last visit of the British Association, the South African Institute of Electrical Engineers, the South African Institution of Engineers, the Cape Chemical Society, the South African Chemical Institute, the Botanical Society of South Africa, the South African Biological Society, the Astronomical Society of South Africa, the South African Geographical Society and the South African Economic Society, and this association of ours has become an active, vigorous and powerful body, proud of the achievements which it already has to its credit, challenging eagerly the tasks that await it in the future. The two observatories of 1905, our visitors will find, have increased to six, including the Smithsonian Solar Observatory in South-West Africa, and the equipment of these institutions includes four great telescopes, with objectives of twenty-seven inches, twenty-six and one half inches, twenty-six inches and twenty-four inches, respectively, to which

will shortly be added a twenty-four-inch refractor and a sixty-inch reflecting telescope—surely a remarkable astronomical equipment for so young a country. The stimulus of the 1905 visit, in which so many prominent European astronomers participated, has indeed borne rich fruit in the advancement of astronomical work in South Africa.

But perhaps our visitors will be impressed not least by the development and consolidation of the scientific departments of our Civil Service, by the magnificent Institute of Veterinary Research which the state has created at Onderstepoort and the effective work which through its scientific officers it is doing for the development of South Africa, and by the remarkably efficient and well-equipped Institute for Medical Research at Johannesburg, the credit of the establishment and maintenance of which falls jointly to the government and the mining industry. Significant also of the attitude of the state to science, and full of promise for the future, has been the establishment of a Research Grant Board, which advises the government on the practical measures necessary for the encouragement of scientific research in the union, and acts as its agent in the distribution of grants in aid of individual investigations.

Nor have we reason to be ashamed of the positive achievements of science in South Africa during the past quarter of a century. Most impressive, perhaps, regarded cumulatively, have been the advances made in our knowledge of the diseases of plants, animals and men, and of the methods of preventing them. In 1905 we knew practically nothing of the plant diseases of South Africa. In that year the first steps were taken towards their scientific investigation. To-day a general survey has been completed, most of the important diseases have been worked out, and a highly efficient service for combating them is in operation. In 1905 also the Transvaal Crown Colony government voted £1,500 as a first instalment towards the establishment of a laboratory for the investigation of stock diseases. From that has sprung the magnificent body of work in veterinary science, which has won world-wide recognition for the Onderstepoort Institution which I mentioned a moment ago. More recently there has been founded the South African Institute for Medical Research, to which is allied the Miners Phthisis Medical Bureau. The researches conducted there in the control of pneumonic infection, and the advances made in industrial hygiene in the fight against silicosis, have brought great luster to these two institutions and to South Africa. But in other fields also South African scientific workers have won recognition. In geology, marine biology, the mathematical theory of determinants, the economics of gold production and along several other lines of investigation, important scientific work has been done in South Africa; a succession of discoveries has been made throwing light on the origins of the human race; and applied science has by means of the conquest of distance in this far-flung land of ours, and of the construction of important irrigation and other engineering works, contributed generously to South Africa's progress. It may, perhaps, be taken as a measure of the achievement of science in South Africa in one of its aspects that, while in 1906 the value of products of the land exported from South Africa amounted to £5,928,000, the corresponding figure for 1927 was £27,815,000.

But if I were asked to select the most broadly significant feature in the development of science in South Africa since 1905, I think I would pick out what one might describe as its South Africanization. In 1905 science in South Africa was in large measure exotic. The workers had come almost exclusively from other lands. They were only beginning to apply themselves to our South African problems. In many cases they had not yet acquired a South African background, or a South African outlook. In the years that have passed South Africa has claimed those workers for her own, and they have given themselves to her service. They to whom this is the land of their adoption, no less than those to whom it is the land of their birth, and whom they have taught and inspired, have made it the land of their vigorous and devoted service. In its personnel science in South Africa has become essentially South African. And science has given itself with enthusiasm to the problems of South Africa. It has emphasized the specific contributions of South Africa to the wider problems of science; it has applied itself to the removal of those obstacles which hamper the material development of South Africa; it has taken up vigorously the study of South African economics and sociology and anthropology. Perhaps also one may claim that it has brought to bear on scientific investigation what we regard as the distinctive features of the South African outlook —freshness and breadth of view, receptivity to new illuminations and readiness to see old truths in new settings and in the light of their wider bearings. Is it not South Africa that has given to science and the world the conception of holism? And there is surely no gift more worthily representative of the South African outlook at its best that we could have offered. It may indeed be that that very South Africanization of our South African science of which I have been speaking is but another instance of the holistic principle at work. As I speak of the South African outlook in science, I can not but refer you with that deep appreciation which I know we all feel to the masterly address which four years ago General Smuts

delivered from this chair, when he demonstrated in so compelling a manner (I quote his own description of the task he set himself) "that there is something valuable and fruitful for science in the South African point of view, that our particular angle of vision supplies a real vantage-point of attack on some of the great problems of science; and that, so far from the South African view-point being parochial in science, it may prove helpful and fruitful in many ways to workers in the fields of scientific research and investigation."

Science in South Africa, then, has made itself truly South African, and in doing so it has established itself in the admiration and affection of the people of this land. As a nation we are grateful to our scientists for their contributions to our intellectual and material progress. The liberal policy of the state in supporting scientific effort we heartily endorse, the increase in the mental stature and the prestige of the nation which science brings to us we sincerely welcome. We are proud of our South African science, not least because we know that we can regard it as distinctively ours. But while our science has been South Africanized, we can rejoice that there is nothing narrow about its South Africanism. Were it otherwise, it would have been false to the spirit of science. In applying itself to the problems of South Africa, it has succeeded in attracting the attention of the scientific world to South Africa. In that address to which I have already referred, General Smuts emphasized the fact that recent events had drawn the eyes of the world to this land of ours as a rich field for scientific investigation. "The scope for scientific work," he said, "in this department of knowledge" (he was referring more especially to human paleontology, but his words are of wider applicability) "is therefore immense; the ground lies literally cumbered with the possibilities of great discoveries. . . . Science has in South Africa a splendid field of labor; other nations may well envy us the rich ores of this great 'scientific divide' which is our heritage." Those words are well worth remembering. We speak sometimes of our wealth in South Africa—mineral wealth, agricultural wealth, potential industrial wealth—but great also is our scientific wealth, and great is the debt we owe to South African science for what it has done to reveal that wealth to ourselves and to the world.

There, then, in brief outlines, all too imperfectly drawn, is a picture of South African science in 1929. Contrast it with the picture of 1905, and you have the measure of the achievement of a great epoch. Science consolidated, science South Africanized, science recognized as of great national value, both in the spiritual and in the material spheres, science drawing to our country the eyes of the world—surely that is no unworthy achievement. And as to-night, once again after the lapse of many days, our association makes its report to the parent body, to which it gladly pays the tribute of filial reverence, it does so with pride and satisfaction in the work of the intervening period, but also with grateful recognition of the inspiration which that visit of 1905 brought to South Africa as one of the constitutive factors in the progress of the last quarter of a century.

And now it has been our privilege to welcome this second visit of the British Association. Is it strange if we ask ourselves, as we gratefully remember the stimulus of 1905, what will be the stimulus of 1929? That visit had abiding results. What will be the results of this one? That visit inaugurated a new epoch. Are we not justified in believing that once again we stand on the threshold of a great advance? If that be so, what are to be the characteristics of the period on which we are now entering, what will be its achievement? In the period that followed the first visit of the British Association we South Africanized science in South Africa. Is it too much to hope that in the next we shall Africanize it? Will not this visit perhaps give us the impulse and the inspiration to a bigger and a bolder enterprise? One of the most significant tendencies evidenced in South Africa in the last few years has been the growing consciousness of our obligations in relation to the continent of Africa. We have come to realize that the position of this European civilization of ours set upon the verge of this great continent is a position of unique strategic importance, that it presents us with at once an opportunity and a challenge. While in the past we thought, as a nation, almost exclusively of our own problems and difficulties, we are now ceasing to limit our horizon by the Limpopo, we are beginning to envisage the task that awaits us beyond our own borders. And in the mind of the nation there is being developed a new conception of South Africa, of a South Africa that consciously and deliberately seeks to play its part on the African continent, not aiming at conquest or domination, but never failing in its readiness to give its intellectual and material resources to aid all who are engaged in the task of developing this great undeveloped area of the earth's surface, which is so full of potentialities for the future welfare of the world. If, then, South Africa aspires to leadership in Africa in other branches of activity, why not also in science? If the outlook of the nation is broadening, why should not its scientists also begin to think in continents? If as a people we are anxious to make our contribution to Africa,

eager to give it of our best, rather than to get from it that which will be to our material advantage, why should not our science also become consciously and deliberately African in its outlook, its ideals, and the tasks to which it applies itself? If science has consolidated its position in South Africa, as we believe it has, is it not fitting that, with South Africa as its base, it should enter now into the new sphere of opportunity and achievement which stretches mightily outwards from its borders?

To you, our visitors, I look to give us the stimulus and the encouragement to that enterprise. You have come to Africa. This great land-mass which has reared itself against time's passage, almost since time's beginning, and holds inviolate so many of the records of that passage, has challenged your attention. You have come to Africa to seek new inspiration for the study of the problems that interest you, by seeing them against a different background which has for many of you an unaccustomed vastness. But while Africa was your goal, you did not think fit to enter it at the point nearest to your homes. You steamed down, day after day, skirting the long coast-line of this vast expanse of veld and forest, and have entered it by its southern gateway. For a great body of scientists, it is the only point of effective entry into Africa. It is by way of this southern gateway that science itself can most effectively be made to permeate Africa. And to you, having so come, to you, the ambassadors of science, I present—Africa. It is Africa and science, which, I would like to think, are to-day met together. Happy indeed should be the fruits of the mating.

It is to that theme—Africa and science—that I propose now to invite your attention. What can Africa give to science? What can science give to Africa? Those are the questions to which I would address myself. But as I speak, I would ask you all to remember that it is for the South African scientist that the answers to these questions have primary significance. It is for him that they have significance, because for the solution of many of the problems of South Africa a greater knowledge of Africa as a whole than is at present available is essential, and the extension of that knowledge is his personal responsibility. It is for him that they have significance because he dwells in a land which is strategically placed for attacking the problems of Africa and for drawing forth its hidden resources of scientific discovery for the enrichment of science throughout the world.

(To be concluded)

OBITUARY

GEORGE PERKINS MERRILL

GEORGE PERKINS MERRILL, head curator of geology in the U. S. National Museum, died suddenly of a heart attack in Auburn, Maine, on August 15, 1929.

Merrill was born in Auburn on May 31, 1854, and was graduated at the University of Maine with the degree of B.S. in 1879. In the autumn of that year he was called to the chemical department of Wesleyan University, where in addition to teaching he pursued advanced studies which gained for him in 1883 the degree of M.S. from his alma mater.

The greater opportunities for scientific advancement led him to Washington, where in 1880 he became connected with the Census Bureau. A year later he transferred his allegiance to the U. S. National Museum, then in the making under the gifted G. Brown Goode with whom he worked congenially and successfully, becoming curator of mineralogy in 1881 and in 1897 head curator of the department of geology. Whatever Merrill undertook to do he did well, and in the organization of the National Museum his contributions stand out as conspicuously great, marking him as one of the foremost museum experts of his time.

Meanwhile he spent the winter of 1886–87 at the Johns Hopkins University in following higher studies which resulted in his receipt of the coveted Ph.D. from Maine in 1889. Also it must be mentioned that in 1893 he became professor of geology and mineralogy at George Washington, with which university he continued his lectures until 1916 when he was made emeritus and a year later was given the honorary degree of Sc.D. in recognition of his valuable services.

In 1900 he was called by the authorities of the twelfth census to become special agent of stone-quarry statistics, and to this work he gave his usual careful attention, preparing an important report for the bureau, enriching the collections of the museum with many valuable specimens and finally, as the result of his painstaking efforts, giving to the public his matured studies on the subject in the popular treatise, "Stones for Building and Decoration,"[1] of which two revised editions, largely rewritten, were published. His researches on this subject led to his book entitled "Rocks, Rock-weathering and Soils,"[2] of which Dr. H. W. Wiley has said: "The greatest work on the genesis of soils we owe to Merrill." He

[1] 1891, 1897 and 1903.
[2] 1897, second edition 1907.

was also the author of "The Non-metallic Minerals—Their Occurrence and Uses."[3] He was an accepted expert on building-stones and his opinions were sought on such important buildings as the Lincoln Memorial and the Washington Cathedral.

The collections of minerals and gems in the National Museum were always conspicuously among his favorites. It was largely through his efforts that the Isaac Lea collection of gems and, more recently, the Roebling and Canfield collections of minerals were presented to the museum and, it may be added, with endowments of funds for their continuance. He was the responsible author of the "Hand-book and Descriptive Catalogue of the Collections of Gems and Precious Stones in the U. S. National Museum.[4]

The collection of meteorites in the National Museum early became one of the objects of his special interest. According to Dr. H. S. Washington, "It is one of the great meteorite collections of the world and it will always remain one of his greatest memorials." Merrill was the author of sixty papers on meteorites in which he describes forty new falls, more, probably, than any other writer. His scientific studies on these interesting objects have been most valuable, especially of the minerals of which these are composed, one of which bears the name of "Merrillite" in his honor. The J. Lawrence Smith medal of the National Academy of Sciences was given him in 1922 in recognition of his researches in this field.

The work which crowned his many contributions in this domain and which brought him much gratification in the closing days of his long life was the publication in 1929 of his joint book on "Minerals from Earth and Sky," which was issued as the third volume in the set of popular scientific treatises issued under the name of Smithsonian Scientific Series.

During recent years much of his leisure was devoted to the history of geology, on which subject his opinion was accepted as the last word. He prepared for the 1904 annual report of the U. S. National Museum "Contributions to the History of American Geology," which rewritten and expanded became "The First One Hundred Years of American Geology," 1924, and he also compiled the valuable "History of American State Geological and Natural History Surveys" which appeared as Bulletin 109 of the museum series, 1920.

His honors were many and included the presidency of the Geological Society of Washington in 1906, vice-presidency of the Geological Society of America in 1920 and membership in the National Academy of Sciences from 1922 and in the American Philosophical Society from 1923.

[3] 1904, second edition 1910.
[4] 1922, issued as Bulletin 118.

Merrill's larger works have already been mentioned and his smaller papers, variously contributed, are more than one hundred and fifty in number. He was never idle and he was a large contributor to nearly all the recent standard works of reference. The definitions of building-stones in the "Standard Dictionary" were by him, and the sketches of geologists in the "Dictionary of American Biography" came from his pen.

Last May on Merrill's seventy-fifth birthday his colleagues and friends celebrated the occasion with a dinner at the Cosmos Club in Washington at which there were more than sixty persons present. At that time the present writer said:

> In a few years the Smithsonian will celebrate its centenary, and I can not but believe that when that event occurs, there will be those who will trace the history of that great institution and who will have much to say about the work of the eminent Henry, and they will review the valuable contributions made by the distinguished Baird. Those who are living in that day will learn more of the researches of the able and much-loved Goode, and will come a little closer to the eminent if disappointed Langley, and somewhere there will be told something of the important results achieved by Merrill, so that his name will shine with added glory among this galaxy of scientists, contributing much to his own fame and reflecting luster on the reputation of the great institution which he has served so faithfully during the many years of his long life.

MARCUS BENJAMIN

RECENT DEATHS

FRANK HURLBUT CHITTENDEN, entomologist in the bureau of entomology of the U. S. Department of Agriculture, died unexpectedly on September 15. Mr. Chittenden was in his seventy-first year.

DR. SETH MACCUEN SMITH, professor of otology at the Jefferson Medical College and head of that department at Jefferson Hospital, died suddenly on September 14. He was in his sixty-seventh year.

SIR EDWARD MAUNDE THOMPSON, distinguished for his work in paleography, for more than twenty years director of the British Museum, died on September 15 at the age of eighty-nine years.

Nature reports the death of Dr. T. J. I'A. Bromwich, F.R.S., formerly fellow and prælector in mathematical science at St. John's College, Cambridge, and university lecturer in mathematics, on August 24, aged fifty-four years, and of Professor S. B. Schryver, F.R.S., professor of biochemistry at the Imperial College of Science and Technology, on August 21, aged sixty years.

SCIENTIFIC EVENTS

NATIVE RACES IN NEW GUINEA

THE London *Times* reports that in furtherance of the efforts that are being made by the Australian Administration of the Mandated Territory of New Guinea to deal with the problem of population, a sociological census is being conducted by the government anthropologist with the object of revealing the causes of depopulation wherever it exists. On the results of the census will depend the measures which the administration will take to arrest the decline.

The investigation of independent anthropologists who are now working in the territory will bear very closely on the matter, particularly as some of these scientists are women and will probably be able to secure accurate information as to the position of the female native, and the extent to which this is connected with the population question. There are at present two women anthropologists working among the natives in the territory. Dr. Hortense Powdermaker, of London University, supported by the National Research Council, has been for some months in New Ireland villages. Dr. Margaret Fortune, accompanied by her husband, Mr. H. R. Fortune (Cambridge), is supported by the American Museum of Natural History, New York, and is investigating social questions affecting the status of women, among the Manus tribes in the Admiralty Islands. Miss Beatrice Blackwood, demonstrator in ethnology at Oxford University, is expected at Rabaul soon to take up similar work. Mr. Gregory Bateson, who holds a research studentship of Cambridge University, has lived for more than a year among the Bainings and the Sulkas in New Britain, and will soon leave for the Sepik to continue his investigations there.

The Crane Pacific Expedition, which is now at work in the vicinity of the Sepik, includes in its personnel Dr. W. L. Moss, of the Harvard Medical School, who is taking blood slides and anthropological measurements of natives. This expedition, financed by a Chicago business man who is also a trustee of the Chicago Field Museum, includes an ichthyologist and half a dozen other scientists who are engaged principally in the collection of biological specimens for the museum.

Recent research workers whose contributions to the anthropology of New Guinea have been published are Mr. G. Pitt-Rivers, who spent some time among the natives of Aua and Matti Islands, and Dr. R. W. Cilento, formerly director of public health in the territory, who, with funds supplied by the commonwealth government, investigated the cause of depopulation in the western islands of the territory. The work of all these scientists will throw some light on the factor, possibly different in every area, upon which it will be necessary to concentrate to arrest depopulation and maintain a virile native race.

The anthropologist attached to the administration, Mr. Chinnery, is now engaged on a sociological census in the New Ireland district, having already spent some months in Kieta.

DISCONTINUANCE OF THE CHILEAN OBSERVATORY OF THE UNIVERSITY OF CALIFORNIA

THE University of California Lick Observatory station at Santiago, Chile, which for a quarter of a century has given California representation in the southern hemisphere of the globe, 6,000 miles or more from the main campus, has been closed.

The regents of the university have given approval to the final report of the sale of the observatory equipment to the Catholic University of Chile, and the disposition of the funds thus secured.

The observatory at Santiago, on Cerro San Cristobal, was established in 1903 for the purpose of obtaining data on the radial velocities of stars in the southern hemisphere of the sky in connection with a survey being made by Dr. W. W. Campbell, now president of the university. The cost of the station was met by the late D. O. Mills, at that time a regent.

It was expected that the work would require two years to complete, but the task proved to be many times more complex than was thought; almost 25 years elapsed before the required data could be accumulated. Among other things it was found that about one out of four supposedly single stars was in reality double or multiple stars composed of two or occasionally more stellar bodies revolving about each other.

During the quarter century of observation at Santiago, almost $200,000 was spent in staff salaries and equipment, which came entirely from private gifts, though the results of the work have redounded to the credit of the university and of the state. The final results of the survey were recently published by President Campbell and Astronomer Joseph Haines Moore.

After the death of Regent D. O. Mills, the chief contributors to the support of the work at Santiago were: Ogden Mills, William H. Crocker, Mrs. Crocker, F. W. Bradley, A. B. Spreckels, Gordon Blanding, Dr. Ambrose Swasey, George B. Douglas, William B. Bourn, Alexander F. Morrison, Mortimer and Hubert Fleishhacker, the Carnegie Corporation, Phillip E. Bowles and an anonymous alumnus of the university.

THE NATIONAL FORESTS OF ALASKA

THE *United States Daily* reports that development work on the national forests of Alaska has been

studied by members of the agricultural subcommittee of the House Committee on Appropriations of Congress, who have made a tour of the national forests with Major R. Y. Stuart, chief of forest service of the U. S. Department of Agriculture. The members of Congress making the tour were Representatives Dickinson (Rep.), of Algona, Iowa; Summers (Rep.), of Walla Walla, Wash; Buchanan (Dem.), of Brenham, Texas, and Sandlin (Dem.), of Minden, La., all members of the House Committee on Appropriations.

Before sailing for Alaska the party inspected some of the work of the Forest Service in the Lake States, the northern and the northwestern forest districts, and visited the Forest Products Laboratory at Madison, Wis., the national forests in the California, Intermountain and Rocky Mountain districts.

In Alaska the party visited the Tongass and the Chugach, the largest and among the least developed of our national forests. Within these forests are vast stands of spruce and hemlock, which will support a large-scale, permanent pulp and paper industry. Two large sales of timber recently made by the Forest Service have paved the way for the establishment of this industry in the territory. Cut under Forest Service supervision on a sustained-yield basis, by which the annual cut will be no greater than the annual growth, the timber will furnish the industry an unfailing supply of raw material.

National forests in Alaska receive a proportionate share of the appropriations under the forest road section of the federal highway act. To date, 185½ miles of forest road have been built where there were no roads or only exceedingly poor roads before. As evidence of the part such roads play in the development of the region, improvements costing more than $4,500,000 have been constructed along these roads, and by connecting formerly isolated communities and making recreation areas accessible, road construction also brings better living conditions. The policy in road construction is to open up undeveloped territory and projects for construction are selected in places where it is believed that the development will follow. Many new projects are needed to take care of present and future needs.

The Forest Service has also expended a limited amount of money for construction of trails. In this work the aim has been to serve fire protection requirements, open up mineral areas for prospecting and provide short recreational trails near settlements, as well as to provide for the administration needs of the Forest Service.

The Tongass and Chugach forests are given forest fire protection by the Forest Service, but the extensive spruce-birch forests of the interior are without protection. The need for organized fire control for these areas has been pointed out to the members of the congressional committee by C. H. Flory, district forester and commissioner representing the Department of Agriculture in Alaska. Mr. Flory recommended as a first step a reconnaissance of the interior timbered areas, to provide information regarding forest values, game and fur relationships, grazing and other values to be protected.

The Forest Service has adopted a liberal land policy in the territory. Valid mining claims are recognized, and withdrawal of lands valuable for agriculture homesites or industrial development is allowed. Land policies are formulated, however, with the fundamental provision in mind that areas chiefly valuable for timber production may be permanently used for that purpose.

THE GRADUATE SCHOOL OF THE U. S. DEPARTMENT OF AGRICULTURE

THE Graduate School of the Department of Agriculture was established in 1921, and from the beginning, up to and including the school year 1927–28, a total of 766 students had registered and taken work in its courses, according to the annual report of the secretary to Dr. A. F. Woods, director of scientific work of the department and director of the school and of the school council. The report gives the following information in regard to the school.

The number of students registered, from 1921 to the year 1927–28, inclusive, 766.

Sources from which the students were drawn:

Bureau of Agricultural Economics	225
Bureau of Plant Industry	137
Bureau of Chemistry and Soils	72
Bureau of Entomology	39
Bureau of Animal Industry	38
Fixed Nitrogen Laboratory	23
City of Washington, D. C.	22
Plant Quarantine, Extension Service, Bureau of Dairy Industry, each	20
Library of Department	19
Forest Service, Bureau of Home Economics, each	17
Geological Survey	16
Bureau of Public Roads	10
Bureau of Biological Survey, Maryland, each	8
Bureau of the Census, Department of Commerce, each	7
Treasury Department, Office of Information, each	6
War Department, Tariff Commission, each,	4
Weather Bureau	3
Food, Drug, Insecticide Administration, Smithsonian Institution, Office of the Surgeon-General, each	2
Office of Personnel and Business Administration, Colorado, Interstate Commerce	

Commission, Veterans' Bureau, Government Printing Office, Red Cross, Washington, D. C., Public Library, Chamber of Commerce of the United States, Department of Labor, Federal Trade Commission, Health Department, District of Columbia, Children's Bureau, United States Shipping Board, each	1

In order to get such information as could be obtained as to the benefits that have been derived from the school by those who have taken work in it, in May a questionnaire was addressed by Director Woods to all the 766 former students of the school. The returns from the questionnaire indicate that the benefits gained by students have in many instances been quite tangible. Many of the former students reported that the certificates earned were valuable to them in their progress toward collegiate degrees, from the bachelor's to the doctor's. Many others reported their belief that they had made professional advancement in their work in the government service as a result of a heightening and broadening of individual efficiency and usefulness.

Fifty-eight persons reported that they had received credit in universities for their certificates earned in the graduate school, and a tabulation of the data in this respect follows:

George Washington University	26
American University	11
University of Maryland	7
University of Minnesota	3
Ohio State University, University of Wisconsin, each	2
Yale University, University of Chicago, The Johns Hopkins University, Louisiana State University, University of North Dakota, Washington State University, Cornell University, each	1

Certificates of the graduate school have been presented and accepted in credit toward collegiate degrees as follows:

Doctor of philosophy	22
Master of arts	7
Master of science	14
Bachelor of arts	6
Bachelor of science	9

One of the outstanding features of the returns from the questionnaire is the deep interest in the graduate school and almost unanimous high regard for it expressed by those who have taken work in it.

The present plan is to send a similar questionnaire out next May to the students of the 1928–29 school year, and to do so each succeeding year, so that an adequate record of the school may be maintained.

For the mutual benefit of administrative officers of the department and the students who have endeavored to increase their value to the government service and themselves by availing themselves of the advantages of the school, Director Woods plans to furnish the chief of each branch of the department a list of those persons of his staff who have taken a course or courses since the beginning of the school year 1926–1927, together with titles of courses and grades received, and to furnish such a list after the close of each future school year.

In the 1928–29 school year 15 courses were offered and 11 conducted—7 graduate and 4 undergraduate. The total number of students enrolled was 226, as compared with 218 in the year 1927–28, and 111 in the year 1926–27.

The first semester of the 1929–30 school year will open the week of October 21.

FORMAL OPENING OF THE CHEMICAL LABORATORY OF PRINCETON UNIVERSITY

THE exercises formally opening the Princeton Chemical Laboratory will take place at 12:30 o'clock (Daylight Saving Time) on the terrace of the laboratory at Princeton University on Thursday, September 26. The university has invited a number of foreign chemists as well as delegates from the universities, colleges and learned societies of this country. The academic procession will leave Nassau Hall at 12:15 p. m., and proceed to the laboratory. Academic costume will be worn. After the exercises luncheon will be served to delegates, invited guests and the members of the department of chemistry. The laboratory will be open for inspection during the afternoon. At 4:00 p. m. tea will be served in the library of the laboratory by the ladies of the department. At 8:30 p. m. a public lecture will be given by Professor F. G. Donnan, C.B.E., F.R.S., of the University of London, on "The Application of Physical Chemistry to Chemical Industry with especial reference to Catalysis."

The exercises will be succeeded on Friday and on Saturday morning, September 27 and 28, by a symposium on "Catalysis and the Mechanism of Chemical Reactions." It is hoped to summarize the main aspects of the problem of chemical reactivity as at present developed. Many of the invited delegates will remain for this symposium. No general invitation has been issued to this discussion, owing to a severe restriction of housing accommodation in Princeton at this time of the year. Those desirous of attending the meetings on Friday and Saturday would greatly oblige the Princeton authorities if they

would signify in advance their intention to be present. While every effort would be made to find such, no accommodations can be guaranteed for overnight visitors other than for the delegates and invited guests. The program of the symposium is as follows:

Friday Morning, 10:00 A. M. (D. S. T.)

(1) Dr. Irving Langmuir: "Chemical and Electrical Properties of Adsorbed Films on Tungsten."

(2) Professor Max Bodenstein: "The Mechanism of the Catalytic Oxidation of Ammonia."

Friday Afternoon, 2:00 P. M. (D. S. T.)

(3) Dr. Francis Perrin: "Fluorescence and the Problem of Negative Catalysis."

(4) Mr. C. N. Hinshelwood, F.R.S.: "Trace Catalysis and Chain Reactions."

(5) Professor M. Polanyi: "Atomic Reactions and Luminescence in Highly Dilute Flames."

Saturday Morning, 9:30 A. M. (D. S. T.)

(6) Dr. K. F. Bonhoeffer: "Parahydrogen, Atomic Hydrogen and the Mechanism of Flame Reactions."

(7) Drs. A. Mittasch and Frankenburger: "The Historical Development and Theory of Ammonia Synthesis."[1]

(8) Drs. H. Mark, Dohse and Kälberer: "Kinetics and Adsorption at Contact Surfaces."[1]

SCIENTIFIC NOTES AND NEWS

THE regular fall meeting of the executive committee of the council of the American Association for the Advancement of Science will occur in Washington on Sunday, October 20. All matters of business and policy that are to be brought before the council at the annual meeting in Des Moines should come before the executive committee at this fall meeting, in so far as that is possible. Communications to be presented to the executive committee should be in the hands of the permanent secretary, Dr. Burton E. Livingston, The Smithsonian Institution Building, by October 15 to make sure that they get properly placed on the order of business and properly presented.

THE Academy of Sciences of Saxony has elected as corresponding members Dr. Graham Lusk, head of the department of physiology of the Cornell Medical College; Dr. A. V. Hill, professor of physiology in the University of London; Dr. Max Planck, professor of physics in the University of Berlin, and Dr. David Hilbert, professor of mathematics in the University of Göttingen.

DR. N. L. BRITTON has been elected honorary president of the recently organized "Cactus and Succulent Society of America," of which Dr. A. D. Houghton is president and Mr. R. E. Willis, of Los Angeles, California, is secretary. The first issue of the *Journal* of the new society, published in July, 1929, records a membership of 350, widely distributed.

AT the Minneapolis meeting of the American Chemical Society the Priestley medal was presented to Mr. Francis P. Garvan, of New York, former alien property custodian, for distinguished services to chemistry. Mr. Garvan gave an address on "Random Thoughts of a Lay Chemist."

W. L. MCATEE, senior biologist, in charge of the division of food habits research, U. S. Biological Survey, has been made a corresponding member of the Royal Hungarian Ornithological Institution "in recognition of his merits in the field of ornithology."

THE first research committee of the American Society of Clinical Pathologists in 1928 planned a memorial to one of the founders and the first secretary-treasurer of the society by the institution of the Ward Burdick Research Award in the form of a gold medal bearing a profile image of the late Dr. Burdick on one side and the society seal and name of the recipient on the reverse. At the eighth annual convention held in Portland, Oregon, the first medal was awarded upon decision of the research committee by the president on the evening of the annual banquet to Walter Malcolm Simpson for his original studies on the subject of tularemia. At the 1928 meeting of the American Medical Association in Minneapolis, Dr. Simpson was awarded a gold medal for his "exhibit of the gross and microscopic changes in tularemia and for excellence of presentation."

DR. F. B. HUTT, associate professor of poultry husbandry in the University of Minnesota, has been awarded the first "Poultry Science Research Prize." This prize of $100 will be awarded annually to the member of the Poultry Science Association who has published the most significant contribution to the field of poultry research. The article upon which the award was based appeared in *Poultry Science*, May 1, 1929, its title being "Sex Dimorphism and Variability in the Appendicular Skeleton of the Leghorn Fowl." Honorable mention was given Dr. Sylvia L. Parker, associate professor of poultry husbandry, University of California, for her article appearing in *Hilgardia*, March, 1929, entitled "Effects of Early Handicaps on Chickens Measured by Yolk Absorption and Body Weight to 20 Weeks."

[1] Papers 7 and 8 will be presented on behalf of the authors by Professor Hugh S. Taylor.

IT is announced in *Nature* that Dr. Norman Dawson Royle has been awarded the Walter Burfitt Prize of the Royal Society of New South Wales for his contributions to the study of muscular action and his investigations into the problems of muscular paralysis during the years 1926–28. This is the first award of this triennial prize, which is to be given for papers of the highest scientific merit by a worker in pure or applied science resident in Australia or New Zealand.

THE Kelvin medal awarded every three years by British industrial establishments has been conferred on M. A. Blondel, inspector general of roads and bridges and a member of the Paris Academy of Sciences. Former recipients of the medal have been Dr. William Cawthorne Unwin, F.R.S.; Dr. Elihu Thomson and Sir Charles Parsons.

A CORRESPONDENT of the *Journal* of the American Medical Association reports that the Accademia dei Lincei held recently its annual formal session in Rome, at its headquarters in the Palazzo Corsini. The royal family was present. Professor Rizzo delivered the academic discourse. The royal prizes were offered, this year, in archeology and in normal and pathologic physiology. The prizes in physiology were conferred on Professor Carlo Foà, of the University of Milan, and Professor Quagliarello, of Naples. The prize in the biologic sciences was bestowed on Professor Visco. Professor Palombi was the recipient of the Grassi prize in parasitology.

DR. FRIEDRICH RINNER, professor of mineralogy at Günterstal-Freiburg, has been elected an associate member of the Heidelberg Academy of Sciences.

DELEGATES from the United States to the first general assembly of the Pan-American Institute of Geography and History meeting at Mexico City from September 16 to 22 are: Colonel Lawrence Martin, chief of the division of maps, Library of Congress, president of the Association of American Geographers and formerly geographer of the Department of State and professor of physiography and geography at the University of Wisconsin; Dr. George Beverly Winton, of Vanderbilt University, and Dr. William Bowie, chief of the division of geodesy of the Coast and Geodetic Survey.

OLAF P. JENKINS has recently been appointed chief geologist to the California State Division of Mines and Mining, and is taking charge of the newly established geologic branch of this division, which is under the supervision of Walter W. Bradley, state mineralogist. The first duties of the chief geologist are to catalogue any published and unpublished material of the state, to evaluate it, to encourage further geological research and to compile the geology of the state with the ultimate aim of constructing a geologic map of California on the scale of 1:500,000.

DR. FRED W. WARD, on account of ill health, has resigned his position of chemist-pharmacologist in the Department of Pensions and National Health at Ottawa, Canada.

MAJOR-GENERAL HAROLD B. FAWCUS has been selected as director general of the army medical services of Great Britain to succeed Lieutenant-General Sir Matthew Fell, who will retire at his own request in September.

Nature reports that the Secretary of State for Scotland and the Minister of Agriculture and Fisheries have appointed the following committee "to investigate the origin, predisposing causes and mode of dissemination of furunculosis and similar infectious diseases among salmon, trout and other fresh-water fish in England and Scotland, and to conduct experiments with a view to ascertaining methods of combating the diseases": Professor T. J. Mackie (chairman), Professor J. A. Arkwright, Mr. T. E. Pryce-Tannatt, Mr. J. C. Mottram, Mr. Douglas Johnston, Mr. W. J. M. Menzies. The secretary of the committee is Mr. William Martin, of the Fishery Board for Scotland, Edinburgh, to whom communications should be addressed. A series of epizootics of furunculosis among salmon and trout in Great Britain in recent years has been sufficiently extensive to occasion considerable damage to valuable fisheries in the rivers affected.

DR. KARL F. MEYER, director of the Hooper Foundation for Medical Research in San Francisco, recently left for Italy at the request of an emissary of the Italian government, to make a study of the canning industry in that country and to complete a report for Benito Mussolini. On his way to Italy Dr. Meyer will visit Switzerland and study the canning industry there as part of a survey of this phase of industry in the leading countries of Europe. He expects to complete his work in Italy by October.

JULIUS FRIESSER and Arthur G. Rueckert, of the zoological staff of Field Museum of Natural History, are about to make a trip to central Canada where they will collect material needed for the completion of groups of certain animals from that region.

DR. ROBERT K. ENDERS, head of the department of biology of the Missouri Valley College, has returned to the Zoological Museum of the University of Michigan after a stay of two months at the Barro Colorado Island Biological Laboratory in the Canal Zone, where he made studies of the mammal life.

DR. CHARLES RICHET lectured on allergy during the week ending on September 21 at the Medical School of the University of California, in San Francisco, and in Oakland.

M. B. DAVIS, chief assistant of the division of horticulture of the Central Experimental Farm,

Ottawa, has been granted a year's leave of absence for special studies at the Research Station, Long Ashton, Bristol, England.

A CORRESPONDENT writes: "Dr. Barton Warren Evermann, director of the Museum of the California Academy of Sciences, has secured for that institution the entire Indiana University collection of fishes. The collection is said to contain more than 200,000 specimens—100,000 of South American species and an equal number from North America and elsewhere. This collection was begun in the early eighties by Dr. David Starr Jordan and his students, among whom were Gilbert, Swain, Eigenmann, Evermann, Meek, Jenkins, Blatchley, Fordice, Fesler, Bollman, Snyder and others. It was more than doubled in size and value by Dr. Carl H. Eigenmann, who, during the period of his professorship at Indiana University (1891–1927), was indefatigable in carrying on personally, or directing, ichthyological explorations in South America. Upon the death of Dr. Eigenmann in 1927, the president and trustees of Indiana University, in view of the fact that there was no one left at that institution to carry on ichthyological studies, deemed it best to dispose of the collection. They wished it to go to an institution where it will receive the best of expert care and where it will continue to be utilized in research as it was for so many years under Dr. Jordan and Dr. Eigenmann and their students. President Bryan and his board of trustees no doubt felt a sentimental interest in having the collection follow Dr. Jordan and Dr. Evermann, his lifelong associate, to California."

As a result of an anonymous gift of $40,000 to match a legislative appropriation of $40,000, Scripps Institution of Oceanography of the University of California is planning for the erection of a new laboratory building. It is planned to have four laboratories in the new building, each dedicated to the study of a different kind of work, including dynamical oceanography and marine meteorology, chemistry, marine bacteriology and the physiology of marine organisms.

DR. LUDWIG PICK, of the University of Berlin, will lecture on pathological anatomy in October before the New York Academy of Medicine.

UNIVERSITY AND EDUCATIONAL NOTES

THE Herztein Medical Lectures, for which the late Dr. Morris Herztein left an endowment of $20,000 to the University of California and Stanford University, will be started this autumn. Dr. Herztein left the residue of his estate to the University of California, approximately $637,000. In accordance with his wishes, $100,000 of this sum will be used as an endowment for a chair of biology either in the Medical School or on the Berkeley campus.

THE HONORABLE CHASE S. OSBORN, of Sault Ste. Marie, Michigan, former governor of that state and a graduate of Purdue University, has given to Purdue 5,200 acres of timber land in the northern peninsula of Michigan, valued at about $200,000, the use of the funds derived from the benefaction being left entirely to the discretion of the university board of trustees.

PROFESSOR NELSON COURTLAND BROWN has been appointed acting dean of the New York State College of Forestry to succeed the late Dean Franklin Moon, who had held the office for nine years. Professor Brown has been head of the department of forest utilization since 1912, with the exception of 1917 to 1921, when he was a member of the United States Trade Commission in Europe, served in the army in France and acted as a consultant to the Republic of Czecho-Slovakia. He graduated from Yale in 1906 and from the Yale Forest School in 1908.

DR. KARL S. LASHLEY, of the Institute for Juvenile Research, Chicago, president this year of the American Psychological Association, will become professor of psychology at the University of Chicago on October 1.

NEW members of the teaching staff of the University of Southern California include Dr. William M. Marston, professor of psychology, and Dr. Lewis Dillon Roberts, professor of physical chemistry.

DR. OSCAR V. BRUMLEY, professor of veterinary surgery, director of veterinary clinics and secretary of the college of veterinary medicine of the Ohio State University, has been appointed dean of the college to succeed Dr. David S. White, who has resigned after serving for thirty-six years.

PROFESSOR W. A. PRICE has been appointed head of the department of entomology and botany at the University of Kentucky to succeed Professor Harrison Garman, who was retired from active service in June.

DR. LOUIS K. OPPITZ has been appointed head of the department of physics at Central College, Fayette, Missouri.

AT the University of Dijon, M. Boutaric has been appointed professor of physics to succeed M. Pionchon and M. Voisenet professor of general chemistry to succeed M. Pigeon.

DISCUSSION

LARGE NUMBERS USED BEFORE THE CHRISTIAN ERA

FOREIGN missionaries and others have frequently called attention to the very limited number developments among some of the uncivilized tribes of recent times. In many cases it has been reported that such tribes could not count as far as ten, and that members thereof frequently referred to even very small numbers by means of such general terms as many or infinite. As people advance in civilization they naturally use the latter of these terms for larger and larger numbers. Hence it may be of interest to note here a few instances where very large numbers were used before the Christian era, especially since some statements in recent American histories of mathematics convey decidedly incorrect impressions along this line.

Even in our day we meet with expressions which imply that the grains of sand on the seashore can not be numbered. It is therefore of interest to recall that Archimedes, who is commonly regarded as the greatest mathematician of antiquity, wrote a work called "The Sand-reckoner" in which he developed a system of numeration which is not only amply extensive to provide different numbers for every pair of grains of sand on earth, but which provides such a vast number of numbers that those required for the enumeration of these grains of sand is a comparatively insignificant part of the available total. The multitude represented by "the sand of the sea" is therefore insignificant in comparison with the multitude of numbers described in a work of Archimedes written more than two centuries before the beginning of the Christian era.

It may be of interest to observe that each of the two Greek mathematicians who are commonly regarded as most eminent in the remarkable period of early mathematical development has associated with his name an extensive system of numeration. The second of these is Apollonius who was a contemporary of Archimedes and used 10^4 as the base of a system of numeration while Archimedes used 10^8 for this purpose. These arithmetic developments are the more worthy of note here in view of the fact that the Greeks are especially noted for their contributions towards the development of geometry. Their contributions towards the development of arithmetic and algebra have perhaps received too little attention in the past as a result of undue credit to the Hindus and Chinese who have made many claims for discoveries which have proved to be unreliable.

In the favorably known "Vorlesungen über Geschichte der Mathematik" by M. Cantor the statement appears that it is probable that the cuneiform notation for numbers used by the Babylonians did not extend as far as one million—at least no such large numbers had then been found. A similar statement has naturally been introduced into many other works on the history of mathematics. Much larger numbers have, however, been found later in this notation, and it is very interesting to note that these extend to $60^8 + 10.60^7$, and thus suggest a connection between this system and that of Archimedes based upon 10^8. At any rate, we have here an instance of the use of a very large number by the ancient Babylonians even if it is much smaller than those used later by the ancient Greeks. In fact, the ancient Hindus and Chinese are also said to have developed a system of enumeration based on as large a number as 10^{53}, but many of the dates relating to early mathematical developments in these countries seem to be uncertain.

The main object of the present note is to direct attention to the early efforts to exhibit linear order in this world by means of large numbers and thus to extend the field to which the considerations relating to finite multitudes apply. The use of large numbers represents an intellectual emancipation from the narrow channels of experience, for if all the human beings that have ever lived on this earth had assisted each other in counting consecutive numbers, each one confining himself to the numbers not counted by any of the others, they would not yet have reached the enormous totality which the system of Archimedes made available. While the contemplation of systems of numeration relating to large numbers is inspiring it has not been as rich in fruition as regards the later development of number theory as some other very early theoretic considerations relating to numbers, for instance, the contemplation of what are known as Pythagorean triads, which seem to have attracted attention at least as early as 4000 B. C.

G. A. MILLER
UNIVERSITY OF ILLINOIS

SOYBEAN CHEESE

IT is probable that the Chinese are the best empirical dieticians in the world. In the course of their thousands of years of civilization the Chinese have accumulated an amazing knowledge of the preparation of foods. This knowledge they have handed down from generation to generation with the greatest fidelity, in recorded and printed form in their cyclopedias and in actual practice from master to apprentice.

The interpretation of these dietary practices in terms of modern science is now under way, with the prospect that the Chinese people themselves will learn how to carry out their established dietary

practices more effectively and more profitably and that after the soundness of these practices has been demonstrated by scientific experiment the rest of the world will receive from China important contributions to knowledge.

At any Chinese restaurant in America one may obtain, by asking for it with sufficient diligence, a cheese made not from the animal protein of milk but from the vegetable protein of the soybean. Persistence in the asking is usually required, because the Chinese manager of the restaurant keeps this food on hand for his own use. It is only in rare instances that his American customers know of it or ask for it.

Soybean cheese is highly salted and its use by the Chinese corresponds very closely to our use of Roquefort cheese. The Chinese do not serve salt on their own tables, but they salt and at the same time season their food by the addition of one of two substances, soybean cheese and soybean sauce. The latter is a brown, salty liquid, also prepared from the soybean. Soybean cheese is excellent when served with salad, meats, vegetables or bread.

Protein is extracted from the soybean in the form of a milky liquid by a process of grinding, boiling and straining. From the soybean milk prepared in this manner the protein is coagulated or precipitated in the form of a white curd by the addition of brine made from impure salt containing as impurities magnesium chloride and calcium chloride, just as cheese curd is precipitated from cow's milk by the addition of rennet. From the soybean curd soybean cheese is made through the process of fermentation described in a forthcoming paper on "A New Species of Mono-Mucor, *Mucor sufu*, on Chinese Soybean Cheese." The author of the paper, Mr. Nganshou Wai, chief chemist of the National Hygienic Laboratory, Shanghai, is a native of Chekiang Province, China, and was graduated in 1924 from the Japanese Imperial University, Kyoto, where he became specially interested in biochemistry. He then worked for two years in the laboratory of Professor Genitzu Kita, at Kyoto, whose studies of fermentation are well known.

Mr. Wai has isolated from soybean cheese a mold which uniformly accompanies the proper fermentation of this cheese, has grown the mold in pure culture, and by inoculating fresh soybean curd with it has produced soybean cheese of characteristic flavor and texture. The original account of the experiments was published in Chinese, with illustrations, in December, 1928, in the Agricultural Journal of the Agricultural College, National Central University, Nanking. Mr. Wai's present paper, an abstract of the original, is the first presentation in English.

FREDERICK V. COVILLE

MANGANESE TOXICITY IN TOBACCO

DURING the season of 1928 peculiar abnormal physiological symptoms appeared on tobacco plants grown in soil in the greenhouse at the Connecticut Agricultural Experiment Station at New Haven. The symptoms were compared with similar symptoms occurring on tobacco plants grown in water and sand cultures at the Tobacco Substation in Windsor, Connecticut. At this latter station a study was made on the effect of manganese on the growth of tobacco. It was found that injury to the plants occurred in water cultures at a concentration of 1 p.p.m. of manganous sulphate, while in sand cultures the injury first occurred at 80 p.p.m. In comparing the symptoms of the injury on plants from the two stations they appeared to be fully identical. Complete analyses were made of the soils used in the New Haven experiment and they were found to be normal except for a high content of soluble manganese and also a high acidity. Later analyses were made of the soils under different fertilizer treatments and also of respective plant material grown on them. A definite correlation was established between reaction of the soil and manganese content of the plant material, *viz.*, the higher the acidity, the greater the percentage of manganese found in the plant material.

In order to determine more definitely that manganese was causing the toxicity a soil of very low content of soluble manganese was placed in a greenhouse flat and planted to tobacco. The plants were watered with a weak (0.5 per cent.) solution of manganous sulphate. The resulting growth was fairly normal and showed only slight evidences of the peculiar symptoms previously noted on plants in the greenhouse pots. Analyses of the soil and the plant material showed considerable amounts of manganese in both cases. The acidity of the soil, however, was not high. More plants were set in the same soil and watering with weak manganous sulphate solution was continued. In this case the growth was identical to that observed on the plants in the greenhouse pots. On analysis both the soil and the plant material contained very high amounts of manganese and the acidity of the soil was higher than in previous tests.

The manganese injury in tobacco may be described as follows: The leaves are sometimes normal in shape and size but are often distorted and dwarfed. The top leaves at first have a yellow-green color. When the leaves are fully developed the yellowish color is minutely distributed in the interspaces of the finest ramifications of the leaf veins, which long remain green. The color grows paler toward the tip. In later stages the entire leaves take on a more yellow color, but the "pattern" remains the same. In still

later stages the leaves may crinkle and brown irregular spots are distributed over the leaf surface.

H. G. M. JACOBSON
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EVIDENCES OF AQUATIC LIFE FROM THE GLENWOOD STAGE OF LAKE CHICAGO

RECORDS of aquatic life during the various stages of Lake Chicago have been lacking for the earliest or Glenwood stage, whose waters stood about fifty-five feet above the present level of Lake Michigan. F. C. Baker points out that the withdrawal or Bowmanville stage of the lake, immediately following the Glenwood, witnessed abundant life in the waters of Wilmette Bay.[1] In the latter part of November, 1928, the junior author discovered minute molluscan shells in the well-stratified silts and clays of the Glenwood stage of Lake Chicago. Later, additional species were collected from the same locality, by D. F. Higgins and the senior author.

The locality where the discovery was made is in the western part of the village of Wilmette, Illinois, in the SE¼ of the SE¼ of Sec. 29, T. 42 N., R. 13 E., Cook County. The area lies in the fields north of Lake Avenue and east of Reinwald Avenue, Wilmette. A master's thesis, written by Miss Marie Devou, of Northwestern University, presents a further description of this region. The surface of the fields is between 625 and 630 feet A. T., or about fifty feet above the level of Lake Michigan. The shells were found about four feet below the surface in that part of the lake plain that was covered by the waters of Skokie Bay during the Glenwood stage of Lake Chicago.

The sediments were screened and washed, and a few more specimens have been found. These were sent to Mr. Baker, who kindly identified them and who lists the following species:

Gyraulus circumstriatus walkeri (Vanatta)
Gyraulus umbilicatellus (Ckll.)
Menetus exacuous (Say)
Helisoma trivolvis (Say)
Stagnicola caperata (Say)
Stagnicola reflexa (Say)
Physa gyrina hildrethiana Lea
Sphaerium occidentale Prime
Strobilops virgo (Pilsbry)[2]
Planorbula n. sp.

The last named is a species soon to be described by Mr. Baker. All the species, with one exception, are fresh-water shells. Mr. Baker states that these species are known in the older deposits of middle Illinois. Doubtless they migrated to the vicinity of the Glenwood beach, where, as Mr. Baker points out, they occupied the warmer waters of the shallow pools behind the beach barriers.[3]

The specimens identified by Mr. Baker have been placed in the Pleistocene collections at the University of Illinois Museum of Natural History. They will become a part of the Chicago Pleistocene collection.

JOHN R. BALL
WILLIAM E. POWERS
NORTHWESTERN UNIVERSITY

THE CAPTURE OF YOUNG WHITEFISH IN THE BAY OF QUINTE

THE young of the common whitefish (*Coregonus clupeaformis* [Mitchill]) have been taken but rarely in scientific collections, and, so far as the writer has been able to ascertain, the only reference to current year fry in the literature is that of Hankinson (1914). The capture of a considerable number of young whitefish in the Bay of Quinte is therefore of interest. These fry were taken close to shore in water of a depth of three feet or less on numerous occasions between April 12 and June 4, 1928. The capture and observation of these fry over a period of some seven weeks provide material which yields valuable information on the early growth, food and habits of this important commercial species. Full details of the early life history of the whitefish will be published at an early date.

J. L. HART
UNIVERSITY OF TORONTO

SCIENTIFIC BOOKS

Comparative Neurology, A Manual and Text for the Study of the Nervous System of Vertebrates. By JAMES W. PAPEZ. Thomas Y. Crowell Company, 1929. xxi + 518 pp., 315 figs. 8vo.

THE author has undertaken the difficult task of producing a combined laboratory guide and text-book on the anatomy of the nervous system. The comparative point of view is introduced in the first chapter with a discussion of the cerebral cortex of some of the lower mammals in relation to their sense-organ equipment. In the following chapters an account of gyri and sulci of the cortex in some of the

[1] F. C. Baker, "The Life of the Pleistocene or Glacial Epoch, as Recorded in the Deposits Laid down by the Great Ice Sheets," Univ. of Illinois Bull., XVII, 41, 1920, pp. 71–73.

[2] A land shell.

[3] F. C. Baker, personal communication.

larger mammals is given, and this is followed by a consideration of the lobes of the cerebrum in several mammalian groups. Part I of the book, which part deals with the gross structures of the mammalian brain, is concluded with several chapters on the brain-stem, cerebellum and spinal cord. The student will gain much from a careful study of this section, which is chiefly descriptive. The investigator will look in vain for many references to the literature, which he may consider should have been included in this and in the other two parts of the book, but the author states in the preface that no attempt has been made to include a complete bibliography.

Part II deals with the microscopic structure of the mammalian nervous system. A series of sections through the brain-stem of the cat is illustrated from original figures. One could wish that the reference letters were more easy to find. The text is descriptive, with occasional paragraphs of interpretation in terms of function. In the chapter on the sympathetic nervous system which is included in this section this system is defined as "the name given to the visceral branches of the cranial and spinal nerves, with the exception of the vagus and glossopharyngeal." Confusion is added to an already chaotic nomenclature by subdividing the system into a "somatic division" and a "visceral or splanchnic division." The somatic division is defined as supplying "the sweat glands, blood vessels and erector pilorum muscles of the skin and blood vessels of striated muscles, body wall and limbs." The splanchnic division the author defines as supplying "the smooth muscles, glands and vessels of the viscera." Many neurologists will not agree with much of the discussion on cerebral localization. The account of the brain-stem, nuclei and fiber tracts is on the whole illuminating and suggestive. Having in mind the student, the author is somewhat dogmatic at times, and omits reference to important contributions in this and in other sections of the book. Within the scope of a single volume, covering so large a field, not every point of view can be expected to appear. A chapter on the physiology of the cerebral cortex gives some of the clinical disturbances met with in man, with some interpretation, and also a summary of studies on conditioned reflexes in animals.

Part III of the book discusses the brains of lower vertebrates, beginning with the reptiles, and ending with a chapter on the evolution of the forebrain. In this section of the book are introduced, briefly, in the chapters on the nervous system in amphibians and fishes, the doctrines of nerve components and functional columns of the central nervous system. Much that appears to the reviewer of fundamental importance to an understanding of the vertebrate brain is treated too briefly.

The volume is attractively got up. The type and paper are good, but typographical errors are rather numerous. Many titles in the bibliographies appended to the individual chapters are given in abbreviated words.

The numerous and well-executed figures of gross and of microscopic structures greatly enhance the value of the book.

O. LARSELL

MEDICAL SCHOOL,
UNIVERSITY OF OREGON

REPORTS

THE COMMITTEE ON AWARDS FOR THE SCIENTIFIC EXHIBIT OF THE AMERICAN MEDICAL ASSOCIATION

THE Committee on Awards reports:

CLASS I

[Awards in Class I are made for exhibits of individual investigations which are judged on basis of originality and excellence of presentation.]

The gold medal to EUGENE P. PENDERGRASS and TEMPLE FAY, Hospital of the University of Pennsylvania, Philadelphia, Pa., for the originality and thoroughness of their contribution to encephalography and the excellence of the presentation.

The silver medal to FRANK W. HARTMAN, Henry Ford Hospital, Detroit, Michigan, for original experimental work on the physiology and pathology of the kidney and for excellence of presentation.

The bronze medal to HOWARD D. HASKINS and EDWIN E. OSGOOD, University of Oregon Medical School, Portland, Oregon, for their contributions to hematologic methods.

The bronze medal to N. W. JONES, B. I. PHILLIPS and OLOF LARSELL, University of Oregon Medical School, Portland, Oregon, for their original experimental work on the treatment of anemia with nuclear extractives.

Certificates of Merit, Class I, were awarded to the following (alphabetically arranged):

B. T. HORTON and G. E. BROWN, Mayo Clinic, Rochester, Minnesota, for clinical physiologic and pathologic studies of diseases affecting the blood-vessels of the extremities.

CLAY RAY MURRAU, Columbia University, New York, for an exhibit of gross and microscopic demonstrations illustrating bone trauma and repair.

CHARLES SHEARD and A. H. SANFORD, Mayo Clinic, Rochester, Minnesota, for demonstration of a new photo-

electric method of determining the percentage of hemoglobin in the blood.

In addition, the following excellent exhibits are deemed worthy of special mention:

That of EBEN J. CAREY, Marquette University School of Medicine, Milwaukee, Wisconsin, illustrating a continuation of the experimental studies of bone growth, for which he received the silver medal in Class I last year.

That of ARTHUR W. ERSKINE, Cedar Rapids, Iowa, on Roentgen therapy technic.

That of C. H. THIENES and A. J. HOCKETT, on the effect of post-pituitary extract on the absorption of drugs from the gastro-intestinal tract.

CLASS II

[Awards in Class II are made for exhibits which do not exemplify purely experimental studies, and which are judged on basis of the excellence of correlating facts and excellence of presentation.]

The gold medal to PHILEMON E. TRUESDALE, Fall River, Massachusetts, for experimental demonstration of the mechanism of transposition of abdominal viscera following rupture of the diaphragm.

The silver medal to A. V. HARDY, University of Iowa, State Hygienic Laboratories, Iowa City, Iowa, for exhibit of various aspects of undulant fever.

The bronze medal to W. T. CUMMINS, Southern Pacific General Hospital, San Francisco; JOSEPH K. SMITH, Kern General Hospital, Bakersfield, California, and C. H. HALLIDAY, Baltimore, Maryland, for exhibit of various aspects of coccidioidal granuloma.

Certificates of Merit, Class II, were awarded to the following (alphabetically arranged):

RICHARD B. CATTELL and SHIELDS WARREN, Lahey Clinic, Boston, for an exhibit of the pathology of the thyroid gland.

J. J. ELLER and N. P. ANDERSON, New York, for exhibit on cancer supervention in skin diseases.

J. EARL ELSE, University of Oregon Medical School, Portland, Oregon, for an exhibit of a study of goiter.

C. C. MCCOY, H. J. GERSTENBERGER, L. P. HARSH and D. G. SHIELDS, Babies' and Children's Hospital, Cleveland, Ohio, for an exhibit of the study of bone disorders in childhood.

JOHN OLIVER MCREYNOLDS, St. Paul's Hospital, Dallas, Texas, for an exhibit of the structure of the crystalline lens system in man and the lower animals.

In addition, the following exhibits are deemed worthy of special mention:

That of C. G. SUTHERLAND, Mayo Clinic, Rochester, Minnesota, showing Roentgenograms of bone lesions.

That of GEORGE W. SWIFT, Neuro-Surgical Clinic, Seattle, Washington, illustrating choked disk.

EDUCATIONAL EXHIBITS

A special Certificate of Merit is awarded to the U. S. Pharmacopeial Convention for the best exhibit in the educational (national organizations) classification. Mention is also made of the excellent exhibit of the U. S. Department of Commerce, Bureau of Mines.

COMMENTS

The committee commends the Special Cooperative Exhibit on Fractures, and desires to thank the members of the committee in charge and also the representatives of the U. S. Army Medical Corps for supplying facilities and for carrying out the demonstrations. The committee commends the exhibit on morbid anatomy, excellently demonstrated by the members of the Committee on Fresh Pathology, which has become an established feature. The committee commends the special demonstration of the biochemical diagnostic methods and desires to express its appreciation of the excellent work of the personnel in charge of the demonstrations.

The committee is impressed by the cooperation of the four sections sponsoring exhibits among their members, and also of the educational and governmental exhibits. It desires especially to commend the exhibits of syphilis of the eye presented by the members of the Section on Ophthalmology.

The committee commends the excellent arrangement of the scientific exhibit, especially the methods used for indicating the nature of the exhibits, the new type of set-up, and the thoroughly adequate illumination, as well as the many and excellent personal demonstrations. The spirit of cooperation on the part of the exhibitors in aiding the management deserves especial recognition.

C. R. BARDEEN, Madison, Wisconsin, *Chairman*
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WILLIAM OPHULS, San Francisco
W. W. WASSON, Denver
O. H. WANGENSTEEN, Minneapolis
G. B. WEBB, Colorado Springs

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR OBTAINING A BREEDING STOCK OF RATS FREE FROM INTESTINAL PROTOZOA[1]

IN planning cross-infection or host-parasite relations studies one of the most serious difficulties encountered is the lack of experimental animals that are parasite-free. As a rule laboratory rats are infected with several species of intestinal protozoa, although different colonies of rats may differ as to

[1] From the department of protozoology, Johns Hopkins University School of Hygiene and Public Health. This work was aided by a grant from the committee on scientific research of the American Medical Association.

the species present. Kessel[2] and Chiang[3] have both reported that amebae-free rats may be selected from colonies in which amebic infections are present. It is possible to find older animals that appear to be entirely free from amebae but, when these animals breed, the young are invariably infected with amebae at the time they are weaned, even though they have not been in contact with any rats except the apparently amebae-free mothers. In view of Kessel's statement that "the most advantageous time to choose rats for feeding experiments is shortly after they are weaned or about the age of two months. Among rats of this age will be found the greatest number free from amebic infections . . ." it seems that his method for detecting amebic infections is not very effective with young rats. Out of two hundred examinations on young rats between four and twelve weeks of age that had been left with infected mothers until they were weaned, not one has been found free from amebae.

In the course of observations on the intestinal contents of rats between ten and thirty days old, it was noted that protozoa did not appear in the intestine of young rats until the rats were twenty to twenty-five days old, and had begun to eat solid foot. It seemed, therefore, that if it were possible to separate young animals from the mothers sixteen to eighteen days after birth, before they became infected (that is, before they began eating solid food) and raise them without further contact with infected rats, that they should remain free from intestinal protozoa.

Accordingly, fifteen young rats, seventeen days old, were separated from the mothers and placed in a clean cage on shavings. During the first two days they were fed whole milk powder dissolved in warm water, the milk being prepared and given fresh three times a day. At first, only a few of the rats would drink from shallow dishes of milk placed in the cage. The others had to be fed by means of a pipette, but after being fed in this way several times they, too, began drinking. On the third day they were started on the stock ration which consists of whole wheat flour 60, whole milk powder 15, unpurified casein 15, butter 5, calcium carbonate 2, ferric citrate 2 and sodium chloride 1, and given water and green vegetables.

Four of these rats died during the first three days, but, from then on, the other eleven grew rapidly. When they were four weeks old, five of them were killed and the contents of the large and small intestine and cecum were examined microscopically for protozoa. The remaining six were similarly examined when they were eight weeks old, and all of them were apparently uninfected. This first group of rats came from two litters, seven in one and eight in the other, and it seemed that better results might have been obtained had the litters been smaller. Hence all the other rats employed came from litters that had been reduced to four animals each. These young were separated from the mothers at sixteen days of age, and none of them died.

The second group, raised in the manner described above, consisted of eight animals. They were kept until they were eight weeks old, then killed and examined, and were negative for intestinal protozoa. The third group also consisted of eight rats, five females and three males. When these animals were twelve weeks old 0.2 cc of material was removed, by surgical operation,[4] from the cecum of each and examined microscopically for protozoa, but apparently these rats were also uninfected. This examination has been found to be entirely sufficient to determine the presence of protozoa that live in the cecum of rats, but does not allow an examination of the small intestine for *Giardia*. Hence these rats were allowed to breed, and half the young from the first litters were killed and examined when they were weaned, but were found to be uninfected. It seems safe to say, then, that a breeding stock of "protozoa-free" rats may be established by this method.

HERBERT L. RATCLIFFE
National Research Council Fellow
(Medical Sciences)

SPECIAL ARTICLES

ACCUMULATION OF GAS IN CLOSED COLLODION SACS IMMERSED IN FLOWING TAP WATER

COLLODION sacs, 16 mm in diameter and about 60 mm long, filled with water or with aqueous solutions of various salts or gases and firmly closed without inclusion of free gas bubbles, when placed in slowly flowing water direct from the Baltimore City water system in April and May of this year, became completely filled with gas in from six to seven days; then during the next few days the amount of gas continued to increase until the walls became quite tense from the evident development of a pressure within the sacs markedly greater than atmospheric. Professor W.

[2] J. F. Kessel, 1923, "Methods of Obtaining Amebae-free Rats for Experimental Infection with Intestinal Amebae." Univ. Calif. Pub. Zool., 20: 401–408.

[3] S. F. Chiang, 1925, "Study of Parasitic Amebae by Experimental Cross-infection of Laboratory Animals," *Nat. Med. Journ. China*, 11: 440–482.

[4] H. L. Ratcliffe, 1928, "The Numbers of Trichomonads in Rats on Diets of Different Protein Content in Relation to the pH and Bacteria in the Cecum," *Amer. Journ. Hyg.*, 8: 910–934.

A. Patrick, of the chemistry department of this university, kindly analyzed a sample of this gas for me and reported that oxygen, carbon dioxide and nitrogen (including other inert gases) were present in normal atmospheric proportions. No bubbles appeared in control sacs placed in flowing tap water which had been submitted in five-gallon bottles to the action of the partial vacuum created by a faucet filter-pump until only occasional bubbles were given off.

The fact that gases in solution in water pass through the walls of such sacs in this positive manner is not recorded, so far as I have been able to ascertain, and certainly is not well known. It seems probable that this is only a particular case of an unrecognized phenomenon common to the behavior of all gases dissolved in liquids and in contact with semi-permeable membranes, and is therefore of interest in several fields of science. For these reasons, it seems advisable to give a more detailed account of my experiments than would otherwise be justified.

Serious distortions of the membranous labyrinth are very common in temporal bone preparations. Since the bone present prevents observation of the effects of each stage of preparation upon this thin-walled closed system mostly surrounded by fluid-containing spaces, closed collodion sacs and glass jars have been utilized in an effort to determine the possibly injurious steps by this rather crude imitation of actual conditions. Collodion sacs of the so-called "moist" type were prepared in the usual way, using test-tubes and an 8 per cent. solution of Parlodion dissolved in equal parts of absolute alcohol and ether. Many such sacs, completely filled with one fluid and with the open end closed by a solid rubber stopper secured by several turns of stretched rubber cord, have been placed in jars of the next fluid used in several methods of preparation. Collodion sacs can not, of course, be used for the study of the effects of the higher alcohols and celloidin nor of fixation as such, but the method has proved very useful for direct observations at other stages.

It was in the course of thus attempting to imitate the standard histologic procedure of washing tissues in running tap water to remove certain fixing fluids or acids or sodium sulphate after acid that the unexpected phenomenon here recorded was stumbled upon. Sacs were filled with each of these several solutions and immersed in jars of running tap water. Whenever this was done, in addition to the volume changes due to osmosis and the diffusions that were to be expected from the nature of the particular fluid, a small gas bubble appeared inside of the sac in the course of a few hours and by the end of two days (a common time for washing large blocks like human temporal bones) was of considerable size. At first I attributed this to the simple release of dissolved air from the water, possibly supersaturated with air while under pressure in the piping system, which had passed into the sac in accordance with well-known laws of osmosis before a complete balance had been reached after release from the faucet. I had suspected this as a possible source of small bubbles in the labyrinth. That this is not a sufficient explanation was soon obvious when some sacs were left in running tap water for a longer time. The gas bubbles continued to enlarge until they completely filled the sacs, and it was noted that the larger the gas bubble at any given time the greater was the amount of gas added during the next equal time interval. Sacs 16 mm in diameter and about 60 mm long became completely filled with gas in from six to seven days, and it was very common for the last half of the filling to take place during the last twenty-four to thirty-six hours. This occurred with sacs filled with any one of the several aqueous solutions and placed in a jar through which was flowing a slow stream of water direct from taps of the Baltimore City water supply during April and May of this year.[1] After visible fluid had completely disappeared and the sacs were filled with gas, if left in the running water the walls became distinctly tense, indicating that the contained gas had increased in amount until it was under pressure markedly greater than atmospheric. The walls of several sacs even gave way.

Some sacs were then filled with distilled water and others with tap water and placed in running tap water in the same way to see if the particular solutions used in the original fillings were in any way responsible, and also whether a preliminary osmotic action due to dissolved salts was an essential factor. So far as concerns filling with gas and developing internal pressure after filling these all behaved in exactly the manner already described. Several repetitions gave identical results. Therefore the presence of dissolved salts does not seem to be an important factor. Further, the rate of increase of the size of the gas bubble during the period of forcing out the contained fluid is evidently not correlated with the amount of water possibly diffusing into the sac and then releasing its surplus gas, but would seem to be associated in some way with the amount of surface of the sac wall in contact with the contained gas.

As controls, tap water which had been partially "degassed" by the action of a faucet filter-pump until bubbles had almost ceased to be given off (thirty minutes to two hours, according to the water pres-

[1] The time of year and the location are specifically indicated because I have some reason to believe that both are factors of importance. At present (late June) it takes longer for similar sacs to fill, and in early June no gas appeared when this was tried in Wilmington.

sure) was siphoned through jars in which were placed similar sacs filled with the same fluid. No bubbles whatsoever appeared in any of the sacs, and when these same sacs with their contents were transferred after several days to untreated tap water, in order to control the possibility that these particular sacs were impermeable, the appearance of the first bubbles was much delayed (from three to five days), but after the bubbles began to form the rate of increase was as before. When sacs which had become partially or completely filled with gas from the ordinary tap water were transferred to jars of running "degassed" tap water (faucet filter-pump treatment) the bubbles gradually disappeared. In three days a sac which had been quite tense with gas became almost completely collapsed. Upon returning it to ordinary tap water it again filled with gas and became tense.

The actual amount of pressure developed by the accumulated gas has been measured in only one sac, and this was done during June, at which time other sacs did not fill as quickly or seem as tense as during April and May, when I believe the values obtained would have been somewhat greater. The sac, filled with tap water and surrounded by running tap water in a suitable container, was connected through a perforated stopper to a water manometer with a leveling bulb arrangement for adjustment of the column height without disturbance of the gas pressure to be measured. In ten days (middle of June) the sac had become completely filled with gas; during the next four days the pressure gradually rose until it reached a maximum that supported 49½ inches of water (a 5-mm diameter tube was used to minimize the surface tension factor). For several days then there was a fluctuation of from two to three inches, apparently correlated with temperature variations in the issuing tap water. Whenever many other faucets on the line were open so that the water was cooler there occurred a decrease of considerably more than can be accounted for by the temperature change of the gas itself. It seems reasonable to assume that the pressure was correlated also with the degree of saturation of the water with gas when freshly released from the piping system at different temperatures. After making such readings for several days tap water which had been submitted to the action of a faucet filter-pump for two hours (and which was warmer than any of the direct tap flow) was run through the container around this sac. The pressure of the gas in the sac fell to zero in ten hours (six gallons of water were used in this time). Then the direct tap connection was again made and in three days the pressure increased to its previous level, thus proving that the fall in pressure was not due to leakage developing coincident with the use of the "degassed" water.

Rigid control of each possible factor, including the study of other membranes, fluids and gases, is needed to determine the laws governing this phenomenon and to work out the true explanation of it. I am not in a position to conduct or to direct such a study, and therefore can only express the hope that physical chemists or others will carry on. When worked out these purely physicochemical laws concerning inert membranes and gases in solution will probably be found of much assistance in understanding some of the phenomena of living matter, such as the gaseous exchanges in respiration and the so-called secretions of gas in various forms.

The significance of these observations as regards distortions of the membranous labyrinth is obvious, and will be dealt with in detail elsewhere; it is equally obvious as regards all the other fields of histologic work in which cavities and delicate tissues are associated and where gas bubbles frequently cause serious damage (embryology, for instance). For the benefit of others who may be troubled with gas bubbles in their tissues a few applications of these observations will be briefly indicated. It is practicable to reduce by filter-pump evacuation the dissolved gas content not only of the water used, but also of many fixing fluids and of the lower strengths of alcohols, and from my own experience to date I am quite certain that by means of this simple procedure (carried out with each fluid just before use, not after the specimen is in the fluid) it is possible not only to prevent the formation of internal bubbles but even to withdraw bubbles that are present without pricking into or cutting valuable specimens. The rate of reabsorption from the atmosphere is sufficiently slow (unless the container is violently agitated) that it is not necessary to cover the surface with oil if a reasonably deep layer of fluid is used and changed daily and the specimen placed well below the upper surface. Even freshly distilled water contains so much air, from absorption during the condensed film stage, that it does not prevent formation of some bubbles and has little or no tendency to absorb bubbles already present unless it has been freshly "degassed." Formalin solutions or fluids containing formalin give off much formaldehyde when acted upon by a filter-pump, but bubble formation is diminished if the water (or the Zenker's or Müller's fluids, for instance) is "degassed" just before adding the formalin required.

STACY R. GUILD
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DOES REGENERATION FOLLOW COMPLETE OVARIOTOMY IN THE ALBINO RAT?

SINCE the time when August Weismann first made a clear distinction between the soma and germ-plasm

and introduced the now familiar idea of the uniqueness and continuity of germ-cells, the origin and history of the definitive germ-cells have become subjects of active investigation.

Interest in this field has been particularly active during the past dozen years. Many cytological contributions have appeared during the interval. Some favor continuity of germ-cells from generation to generation, and, by inference, at least, support the hypothesis that all germ-cells now in existence go back in an unbroken line to the germinal materials of the first living thing upon the earth; others find evidence supporting the view that there is a discontinuity of germ-cells between the generations, each crop of definitive germ-cells arising *de novo* from the peritoneum of the gonads. Therefore, according to this school, soma-cells proliferate germ-cells.

The subject-matter of this preliminary note deals, however, not with the cytological aspect of the origin of germ-cells, but with an attack upon the problem from an entirely different angle.

Davenport,[1] spaying mice, found that, after a lapse of from eight to forty-five weeks, regeneration of the ovaries occurred in 64 per cent. of his animals. Complete removal of the ovary was claimed, but cytological evidence in support of this was not secured. Macroscopic examination of masses of tissue at or near the site of operation was the criterion for regeneration of the ovary.

Haterius[2] secured four cases of regenerated ovarian tissue in mice out of seventy-six operations, and attributed these to incomplete ovarian extirpation. Parkes, Fielding and Brambell[3] had 121 cases of double ovariotomized mice. After ovariotomy the oestrous cycle (vaginal smear method) ceased. But in eleven cases spontaneous oestrous subsequently occurred, and this was taken to indicate regenerated ovarian tissue. In eight of these eleven cases the presence of new ovarian tissue was demonstrated histologically.

Hanson and Heys[4] added data of a similar nature from the albino rat. Both ovaries were removed from 105 rats and each ovary preserved for sectioning. The animals ranged in age from ten to two hundred days at time of operation. The period allowed for regeneration ranged from ninety to one hundred and eighty days. There were eight cases of ovarian regeneration as determined by sectioning the regenerated masses of tissue. The eight original ovaries removed from these sites of regeneration were then sectioned to determine whether the whole ovary had been removed.

In two of the eight original ovaries incomplete removal was demonstrated cytologically, while in six cases extirpation was apparently complete. This gives a regeneration rate of 3.5 per cent. in the rat.

It was observed by Hanson and Heys that no rats under forty days of age showed regenerated ovaries, and the suggestion was made that the chance of success in complete removal of the ovary increases as the age at which animals are spayed decreases. This is due to the fact that the immature ovary is a small ovoid body, freely movable and not yet embedded in the fat body. On the other hand, the mature ovary is surrounded by the fat body and very irregular in shape due to the presence of numerous corpora lutea, hence the difficulty of complete removal.

With these facts in mind a second experiment with rats under forty days of age (range ten to forty days) was performed. One hundred and eight rats were operated upon. Both ovaries were removed. As expected from the results of the first experiment there was no regeneration at all in rats under forty days of age. In this experiment a few operations were performed on sexually mature rats as a check on those under forty days of age. After operating upon over 213 rats some skill in removing the entire ovary was attained, yet so great are the difficulties in getting out the adult ovary from surrounding fat that again three cases of regenerated bodies were found in these older rats.

CONCLUSION

These two experiments seem to show that in the rat it is easily possible to be certain of getting out the entire ovary in young rats (under forty days old) and that upon complete removal no regeneration occurs.

It also seems plausible to believe that in older animals the regeneration that occurred in these experiments, as well as in those of other workers, was due wholly to the difficulties attendant upon a perfect ovariotomy

In so far as these experiments have a bearing upon the problem of the origin of the germ-cells they lend no support to those cytologists who trace definitive germ-cells to a peritoneal source.

Complete experimental data with a critical discussion of the cytological and experimental evidence will be published elsewhere.

FLORENCE M. HEYS

WASHINGTON UNIVERSITY

[1] C. B. Davenport, *Jour. Exp. Zool.*, 42: 1–11, 1925.

[2] H. O. Haterius, *Proc. Soc. Exp. Biol. and Med.*, 24: 784–786, 1927.

[3] A. S. Parkes, W. Fielding and F. W. R. Brambell, *Proc. Roy. Soc.*, Series B. CI, 328–354, 1927.

[4] Frank Blair Hanson and Florence Heys, *Proc. Soc. Exp. Biol. and Med.*, 25: 183–184, 1927.

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SCIENCE NEWS

Science Service, Washington, D. C.

SCIENTIFIC STUDY OF THE NORTH PACIFIC

CANADA and the United States from the east, Japan, China and Russia from the west, will meet in mid-Pacific in less than ten years with a well-rounded preliminary picture of the biology and physical oceanography of the northern section of that great ocean. This is the prophecy of Dr. T. Wayland Vaughan, director of the Scripps Institution of Oceanography, made after a survey of the programs of ocean science now embarked upon or contemplated by the powers bordering upon the North Pacific.

Currents, tides, winds, air and water temperature—all the complex phenomena that interact to make climate in air above, and what might be termed "water climate" in the aquatic element beneath, form one part of the program. The geology and geography of the solid land that forms the shores, and of the deep-drowned rocks that make up the ocean basins, jutting up here and there as islands or volcanoes, occupy another section. Then there are the multitudinous forms of life that swim as fishes and whales, or float as sea-jellies and protozoa, or cling and creep on the bottom, as well as the plant life, ranging from microscopic single cells to hundred-foot kelps, on which the animal life ultimately depends. A fascinating and challenging group of problems can be found where biology becomes geology, that is, in the formation of coral islands and reefs.

All these phases, and others besides, are actively under way in the North Pacific area, and it is here that the most rapid advances may be expected, according to Dr. Vaughan. Promising initial steps are being taken in the southwestern Pacific also. As yet little has been done in the southeastern section of the ocean, although some of the South American countries, notably Chile and Peru, have evinced interest and may eventually bring the scientific knowledge of their oceanic "spheres of influence" up to the level of that attained in regions where an earlier start has been made.

VOLCANIC ERUPTIONS IN HAWAII

How much lava a volcano can disgorge, even in short-lived eruptions, is indicated by calculations by Dr. Howard A. Powers, of the Hawaiian Volcano Observatory. A cubic box, one and a sixth miles on each side, would be required to hold the lava that has been left in the inner pit of the Halemaumau volcano in the three brief eruptions that have occurred since 1925. These figures have enabled the volcanologists to predict another eruption this fall.

In the period since 1925 a total of 8,692,000 cubic yards of solidified lava has been left in the pit, filling it to a depth of 210 feet. Actually, even more lava than this has been given out, but some of it sank back after the eruptions. For instance, the eruption of July 25 brought a total of 136,850,000 cubic feet of molten lava into the pit, but when it subsided, only 97,350,000 cubic feet of the solidified lava remained.

The previous eruptions in the period measured were in July, 1927, which left 85,430,000 cubic feet of lava, and in February, 1929, when 51,900,000 cubic feet additional remained.

From these data, Dr. Thomas A. Jaggar, director of the observatory, has formed the opinion that "the intensity of gas action and the freedom of flowing has increased in 1929, and at the same time the interval between outbreaks has decreased."

Dr. Jaggar has plotted a curve of the outbreaks, and this makes it appear that "the next inflow of lava should take place some time between now and November, 1929. This expectancy might be interfered with if Mauna Loa should erupt, but that would be an equally satisfactory demonstration that the Hawaiian lava column is alive."

RECORDING CALIFORNIA EARTHQUAKES

THE dots and dashes of radio transmission from an ordinary commercial station are now checking the times of southern California earthquakes. At the seismological laboratory of the California Institute of Technology, the code messages from the station are continually received and recorded by a flashing light on a revolving sheet of photographic paper. An accurate clock is recorded on the same sheet, so that the exact time of any dot or dash may be determined.

Scattered throughout southern California are a number of other seismograph stations, cooperating with the central station. At each of these is a similar automatic radio recorder, continually taking down the messages of the station. A clock, in which accuracy is not essential, records its ticks on the same sheet with the radio records. The same clock makes similar marks on the sheet on the seismograph drum, where the earthquakes are recorded.

In use, this permits the seismologist to tell the exact time at which the earthquake waves reach any station. For instance, suppose an earthquake record begins while the station is sending the word "ship." At Pasadena the record starts on the letter "s," while at Santa Barbara it begins on the letter "h." As the signals arrived at both stations simultaneously, the difference is due to the greater time it takes the wave to travel to Santa Barbara, and from the records of the standard clock at the central station this time may be precisely measured.

From the studies thus being made, it is planned to detect even the slightest tremblings of the earth in this region. From this it is hoped that enough may be learned of the dangers, so that proper precautions can be taken to prevent damage by earthquakes, or that a severe quake might be predicted sufficiently far in advance to prevent loss of life.

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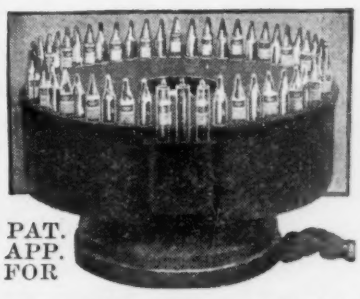

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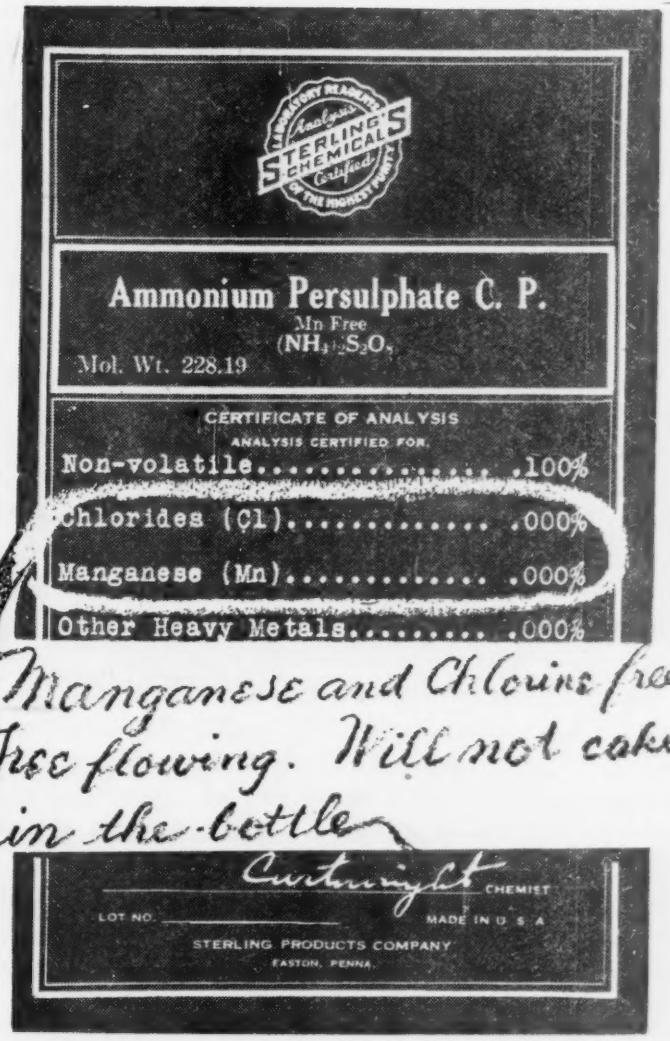

"micro-spectroscope" may supplant the time-honored acid tests now employed by gem dealers.

Dr. Edgar T. Wherry, of the U. S. Bureau of Chemistry and Soils, who has developed this unique test, will describe the phenomena revealed by the different stones in an article to be published soon in the *American Mineralogist*. In connection with the article he will present hitherto unpublished tables, giving the mathematical measurements of the color and absorption bands for red, blue and green stones.

The identification, Dr. Wherry explains, is made by means of the very interesting phenomena revealed by the spectroscope. Light thrown by the gem is broken up into its component parts of red, orange, yellow, green, blue and violet, the colors being arranged in the order of their wave-lengths as in the rainbow. The widths of the color bands vary according to the mineral substance, and the black absorption bands between the colors likewise vary, both in width and intensity.

A red stone, for example, might be glass, garnet, synthetic ruby or ruby, worth from ten cents to two hundred dollars. The spectroscope, inserted in the eyepiece of a microscope, quickly analyzes the light from the stone, arranging the color bands and black absorption bands in a pattern that reveals the true composition without possibility of error, because the patterns for no two gems are alike.

Dr. Wherry states that as far as clear, colored stones are concerned, such as rubies, sapphires and emeralds, the new test is far more certain than the old methods of subjecting the stones to acid or scratching them with minerals, which often injure the jewel. In a spectroscope test the stone does not even have to be removed from its setting and even a minute fragment can be identified.

MILK AS A SUBSTITUTE FOR LIVER

ATTEMPTS to increase the nutritional value of milk by the simple technique of giving cows and goats more copper salts in their food than they would normally have access to has failed to work.

The valuable factor in liver, which has become the up-to-date physician's most substantial prop in treating pernicious anemia, was recently found by Dr. E. B. Hart and a group of investigators at the University of Wisconsin to be copper rather than iron, as was first believed. Liver in the proportions necessary to produce curative effects becomes an exceedingly disagreeable medicine to many patients. Other foods, consequently, that supply the needed element are highly desirable.

Naturally the Wisconsin investigators turned their thoughts to various ways of increasing the copper content in other foods. Milk, which in earlier analyses showed from .38 to 1.4 milligrams of copper per liter, was found under carefully controlled conditions to have only .123 to .184 milligrams per liter, not sufficient to prevent rats, fed on a milk diet, from developing anemia. The earlier figures are believed to be the result of contamination with copper from metal vessels used during analysis.

Cows and goats fed on an experimental diet showed milk with the same proportion of copper as that found in the recent analyses. Increasing the copper content of their food even in considerable proportions, however, did not produce any increase in the amount of the element in their milk. So anemia patients can't look to milk for relief from liver.

CHLOROPHYLL AND PLANT GROWTH

PLANTS whose leaves contain the most chlorophyll are the most efficient at the business of making new plant tissue—which is, from the farmer's point of view, the chief end and object of plant existence.

Ever since pioneer plant physiologists found out what chlorophyll is, and learned that its function is to capture carbon dioxide out of the air and with the help of sunlight to combine it with water to make sugar, it has been taken for granted that the more chlorophyll a plant has per square inch of leaf surface the faster it can make new stems and leaves.

It has remained for Dr. H. B. Sprague and Dr. J. W. Shive, of the New Jersey Agricultural Experiment Station, to determine the relation accurately, using the exact analytical methods of the chemical laboratory. They have recently reported their results in detail to the American Society of Plant Physiologists.

They grew standardized breeds of corn under carefully controlled conditions. They supplied nutrient chemicals at a known rate. They measured the areas of leaves, extracted the chlorophyll and determined its quantity per square centimeter, and weighed their plants as they harvested them.

Correlating their data, they found that the strains with the most chlorophyll per unit area had produced the most cornstalk in a given time. They also found that the plants which produced the greatest spread of leaves were most efficient at the business of growth. A yellow pigment, carotin, which is found in leaves, bore a similar relation to the rate of new stalk and leaf production as did the chlorophyll.

TUNGSTEN CARBIDE

TUNGSTEN carbide, the hardest compound known to science, and for years a mere curiosity, has now begun to find extensive commercial use. With it, hard alloys, such as manganese steel and armor plate, can be machined in lathes, planers and shapers, says Dr. Samuel L. Hoyt, of the General Electric Co., in a report to the Engineering Foundation, soon to be published in *Research Narratives*.

One of the constituents of this remarkable substance is tungsten, the familiar metal of which the filaments of our electric lamps are made. Though years of research resulted in a process of making tungsten so soft that it could be drawn into fine wires, when combined with carbon it makes a substance second in hardness only to the diamond. Tungsten carbide will scratch a sapphire, which is the second hardest natural mineral.

At first, despite its hardness, tungsten carbide was too porous to stand the strain imposed upon a cutting tool. But researches of Dr. Hoyt and his associates have shown

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how these difficulties can be overcome. In this form it it known commercially as "carboloy."

"In testing high-speed steel tools," said Dr. Hoyt, "it is customary to use a 'test log,' *i.e.*, a long, round bar of nickel-steel, making a cut in it at about 50 feet per minute. Because of the lack of effect on the carboloy cutter, however, it was necessary to increase the speed to 200 feet per minute. At this speed a high-speed steel cutter failed in 16 seconds, with its edge burned off. The tungsten carbide tool, under identical conditions, was run for an hour before the test was arbitrarily stopped, although the tool was still cutting and capable of continuing for a much longer time.

"Consequently, the carbide tool in many operations effects substantial savings of time and costly labor. In others it gets much better results. With it numerous operations are feasible which are not possible with any other known tool material. Nevertheless, the alloys of tungsten carbide have limitations. They will break down, for example, in work involving very heavy pressures on the tools. Carboloy is as yet on the market only to a limited extent, although it has been in practical use for the past three years. A great advance in the art of cutting metals appears to be in immediate prospect."

NATIONAL PARKS IN SOVIET RUSSIA

THROUGH the Institute for Natural Sciences, Soviet Russia has established nature reserves for safeguarding its wild life comparable to the national parks of America, according to reports received at Berlin recently.

After the chaos of the revolution, when many of the rare animals of Russia preserved on the hunting estates of the Czar and the nobility were destroyed, considerable effort is being expended to restore the sable, sea otter, wisent and other fast-disappearing game to some semblance of their former numbers.

Prominent among the reserves set aside for protection is a tract of land of approximately 1,097 square miles in the Caucasus where there flourished formerly a herd of wisent, an old-world cousin of the American bison, now thought to be extinct except for a few zoological park specimens. When the grand dukes held hunting reserves in this region there were about 700 of them. A scientific expedition, sent there recently, failed to find a trace of this herd. The ibex, of alphabet-block fame, still survives in this section, however.

A small park of about 55 square miles has been established at Ilmen, one of the most beautiful parts of the Urals, said to contain a natural collection of 150 different kinds of precious and semi-precious stones.

At Astrachan, in the Volga delta, is a bird preserve of 88 square miles. A somewhat smaller area in the Crimea has been made a preserve of moufflon and various kinds of deer. A rest station for migrating birds has been located in a marshy region midway between the Caspian Sea and the Arctic. Besides these there are many other small government reserves, notably the estates of the writers Tolstoi and Pushkin, and the island of Kondo in the White Sea set aside for the eider duck.

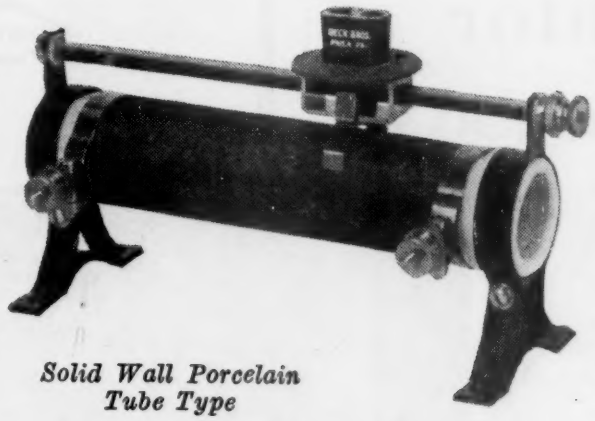
In spite of the national interest in parks, the game laws, promulgated in 1924, still leave much to be desired. Under this edict it is made more or less a public duty to kill the larger predatory animals such as leopards, lynxes and wolves. Some of the former are extremely rare and might well enjoy a closed season. The eagle and various other rare birds of prey have also been put in this category.

ITEMS

REPORTS received by the Forest Service indicate that a total of 653,000 acres of National Forest land has been destroyed by forest fires this year in the territory west of the Mississippi. The cost to the government for emergency fire fighting measures has amounted to $2,100,000 in the short time from July 1 to September 10. That means that more than $20 is being spent every minute in the defense fund. The only possibility of putting out the raging flames lies in the very faint chance of rain. Weather Bureau experts do not believe that there is much likelihood that rain will come in the near future over western Washington and Oregon where the fires are the worst. The present forecast is for an increase of wind, without rain, which condition would only aggravate the present unfavorable weather state.

THE green patina that appears on copper roofs or drainpipes after years of service and that gives the metal its attractive appearance is due chiefly to sulphuric acid present in the air from coal smoke. This conclusion was announced at the meeting of the Institute of Metals, an English society now holding its first meeting in Germany, by Dr. W. R. J. Vernon and L. Whitby, of the Chemical Research Laboratory at Teddington. Samples of copper from buildings in London and other parts of England were studied. Some were as old as three hundred years. In the city specimens, the patina consisted of basic copper sulphate, caused by the action of atmospheric sulphuric acid. A piece of telegraph wire, exposed for 13 years within 200 yards of the sea, showed a patina consisting of basic copper chloride, the chlorine having been furnished from the salt water. At first, they found, the red copper turns black, but then the green patina develops later, and remains indefinitely.

TWO whooping cranes, representatives of a species almost as extinct as the passenger pigeon, were seen by Dr. E. W. Nelson, former chief of the U. S. Biological Survey, on a recent trip along the coast marshes of Louisiana. A hundred years ago whooping cranes, five feet tall standing, and almost pure white, used to fly over the prairies at migration times in vast armies. The clamor rising from the trumpeting of the vast hordes, early naturalists tell us, was almost deafening. Now, thanks to their size, conspicuous plumage and commendable flavor on the dinner table, they have virtually vanished. Dr. Nelson reported to the Cooper Ornithological Club that the Louisiana cranes were the first specimens he had seen in the field since 1870. According to local trappers, the pair seen by Dr. Nelson were the only ones in the region and had wintered in the marsh four successive years without rearing any young.



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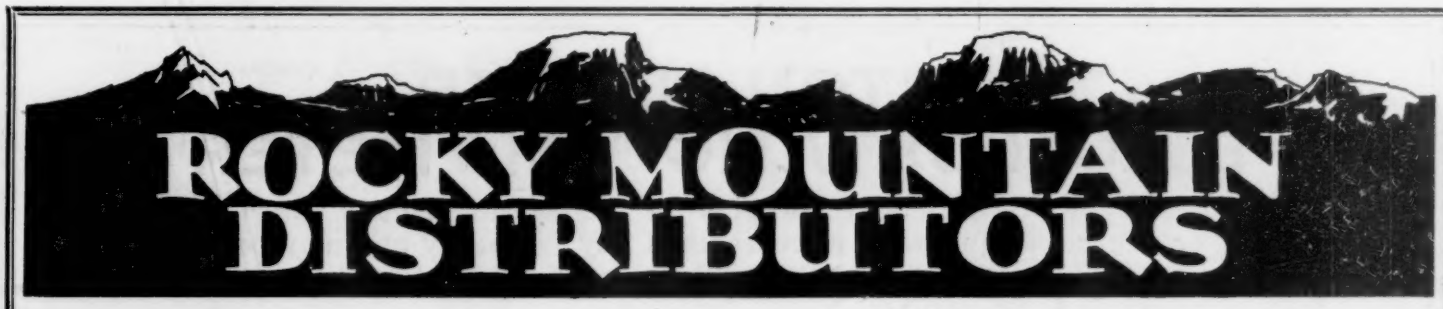

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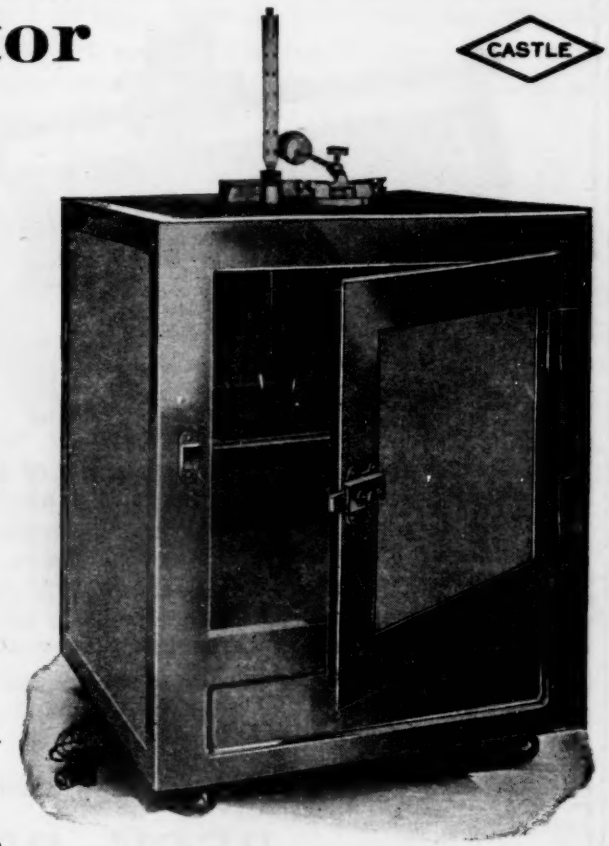

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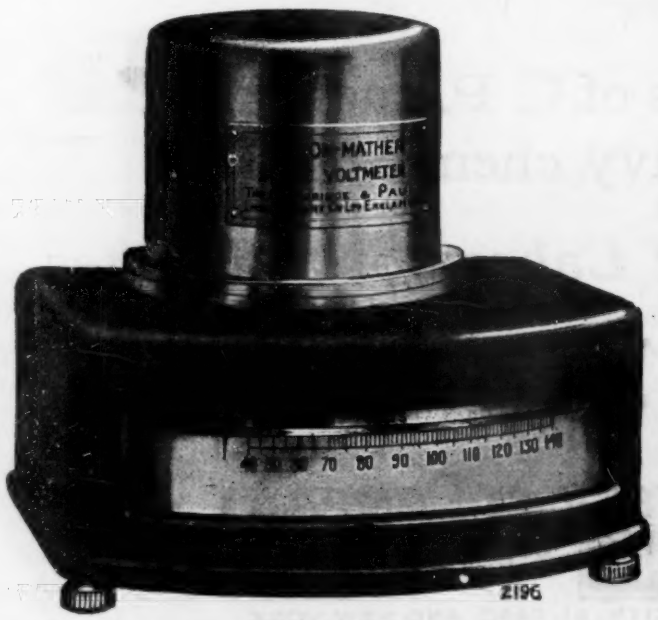

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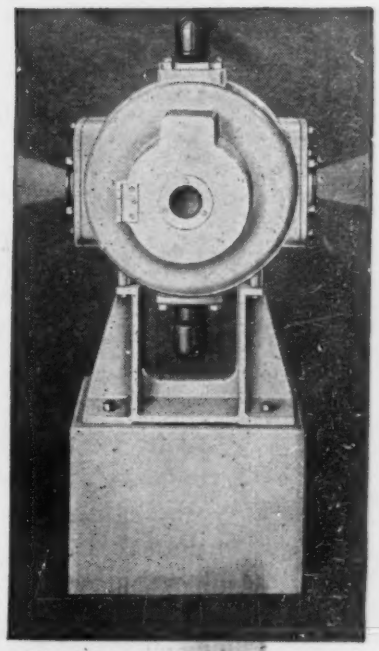

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